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GeoScience Abstracts

Vol. 1, No. 1

January 1959

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The American Geological Institute operates under the National Academy of Sciences. The Institute is a federation of fourteen scientific and technical societies in the fields of geology and geophysics. The AGI is governed by an Executive Committee and a Board of Directors composed of two directors appointed by each of the Member Societies.

GeoScience Abstracts is published monthly, beginning with Volume 1, Number 1, January 1959, and replaces Geological Abstracts which was discontinued by the Geological Society of America at the end of 1958. The journal has received a grant in aid from the National Science Foundation to provide initial working funds.

GeoScience Abstracts will work toward complete coverage of all significant North American literature in geology, solid earth geophysics and related areas of science. It will also include abstracts in English of Soviet literature, particularly from the Referativnyi Zhurnal, as the translations are processed by the AGI Translation Center. The journal will have a monthly author index and an annual subject index.

To attain the goal of essentially complete coverage of all significant North American literature in the field, GeoScience Abstracts will need the full cooperation and aid of the profession. Suggestions as to additional sources of literature to be covered will be gratefully received by the editorial staff.

SUBSCRIPTION RATES

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GeoScience Abstracts

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Vol. 1, No. 1 January 1959

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FOREWORD

GeoScience Abstracts has been started by the American Geological Institute to replace Geological Abstracts, published since 1953 by the Geological Society of America for the Member Societies of the AGI. Initial working capital for the reorganization and expansion of the journal has been provided through a grant from the National Science Foundation.

The journal is to be published monthly beginning with this issue, January 1959. GeoScience Abstracts will work toward complete coverage of current geological literature published in North America. In addition, selected abstracts of Soviet geological literature, primarily translated from the abstract journal Referativnyi Zhurnal, will be included as these are processed by the AGI Translation Center. More extensive coverage of international literature is not anticipated at present.

Abstracts in the new journal will be organized into fifteen subject sections (shown in the Table of Contents) dealing with geology, solid earth geophysics, and related areas of science. An especial effort will be made to provide effective coverage of geologic maps and guidebooks. A monthly author index and a yearly subject index will be provided. GeoScience Abstracts will continue to concentrate on author abstracts in an effort to provide a prompt, economical abstract service for the profession. Considerable variation now exists in such abstracts, and the journal will be dedicated to the task of promoting abstracts which will meet more exacting standards of length, content, and quality. Obviously, not all literature can be covered by author abstracts, so GeoScience Abstracts proposes also to use volunteer abstracting where necessary.

The cooperation of all regular geology-geophysics and other scientific journals is being sought, as is the aid of appropriate government agencies in Canada, Mexico, and the United States. Colleges and universities which publish research results are being invited to contribute. Many special arrangements must be made to provide coverage of journals in which geologic material appears infrequently.

The major geological and geophysical journals have cooperated fully to provide abstracts of papers appearing in current issues. Geological surveys and departments of mines in the United States and Canada have been extremely cooperative in sending full abstracts and adequate bibliographical information on their publications.

The keystone to the success of GeoScience Abstracts will of necessity be the cooperation of the profession. The full coverage of the literature can come only with the full and willing assistance of the profession, its authors, and its publications. High quality and improved uniformity of author abstracts can come only with the concerted efforts of authors and editors. The profession in return for the required cooperation should have an abstract journal which will provide essentially complete and prompt coverage of significant, current, available literature. This will not be achieved quickly. It may take up to five years to bring GeoScience Abstracts near the desired level of coverage.

The first issue of the journal contains 291 abstracts; 3500 to 4000 abstracts are expected during the first year. Material received after January 16 was not included in this issue, and, in general, material received after the fifteenth of each month will be included in the issue for the following month. With a few exceptions, abstracts in the January issue represent papers published during the last quarter of 1958 and in January 1959.

Bibliographical information accompanying abstracts in this issue is not as complete or as uniform as desired. Inconsistencies and omissions in citations of publications result primarily from lack of information received by the editorial office. In the case of regular journals, more complete and accurate citations and indexing will result if copies of published journals or complete page proofs are sent regularly to GeoScience Abstracts.

Abbreviations in the citations are those approved in the U. S. Geological Survey, Suggestions to Authors of the Reports of the United States Geological Survey, 5th ed., 1958, p. 111-14. Full titles of institutions and serials cited in abbreviated form in this issue are given in the list of serials. For papers in languages other than English, the titles are given in the original language, followed by the English translation.

Abstracts have been credited to individual writers or to the organization responsible for the abstracts, if the individual abstracter is not known. Unsigned typed abstracts sent by state and provincial government agencies have been credited as author abstracts unless a correction has been sent us by the organization concerned. Abstracts of Soviet publications, sent to this office by the AGI Translation Center, have been prepared by the Library of Congress, with some editorial changes made by the Center. These abstracts have been credited to LC. U. S. S. R. geographic names used in the texts of the abstracts have been checked with the U. S. Board on Geographic Names.

Much assistance in planning has been given to the staff of GeoScience Abstracts during the past two months, particularly with regard to the subject sections. Appreciation for this assistance is here expressed, especially to Z. S. Altschuler, Michael Fleischer, Mary C. Rabbitt, Marie Siegrist, Dorothy Vitaliano, C. L. McGuinness, Alice Allen, Rhodes Fairbridge, and Earl Ingerson.

It is planned that an editorial advisory board will be established to further shape and guide the policies of GeoScience Abstracts. The editorial staff consists of Miss Anne C. Sangree, associate editor, and Miss Gracemary E. Denegar, assistant editor. This finished camera-ready copy is typed by Mrs. Frances K. Burleson of the AGI staff. Page make up and printing is done by the Williams & Heintz Lithograph Corporation of Washington.

SERIALS

The following list gives in full the abbreviated citations used after the titles of papers in this issue of GeoScience Abstracts.

Akademiya Nauk SSSR, Izvestiya, Seriya Geologicheskaya. Moscow-Leningrad.
Alabama, Geological Survey, Information Series; Map. University, Alabama.
American Association of Petroleum Geologists, Bulletin. Tulsa, Oklahoma.
American Geophysical Union, Transactions. Washington, D.C.
American Journal of Science. New Haven, Connecticut.
American Mineralogist (Mineralogical Society of America). Ann Arbor, Michigan.
Arizona Bureau of Mines, [Maps]. Tucson, Arizona.
California, University (Los Angeles), Institute of Geophysics, Publication. Los Angeles, California.
Compass (Sigma Gamma Epsilon). Provo, Utah.
Economic Geology (Society of Economic Geologists). Lancaster, Pennsylvania.
Florida Geological Survey, Information Circular. Tallahassee, Florida.
Geochimica et Cosmochimica Acta. London-New York.
Geological Society of America, Bulletin; Memoir. New York.
Geologiya Nefti (Ministerstvo Neftianoi Promyshlennosti SSSR). Moscow.
Idaho Bureau of Mines and Geology, Bulletin; County Report; Pamphlet. Moscow, Idaho.
Illinois, State Geological Survey, Circular. Urbana, Illinois.
Indiana, Geological Survey, Atlas of Mineral Resources of Indiana, Map; Bulletin; Circular; Report of Progress. Bloomington, Indiana.
Journal of Geology. Chicago.
Journal of Geophysical Research. Washington, D.C.
Journal of Paleontology. Tulsa, Oklahoma.
Journal of Sedimentary Petrology. Tulsa, Oklahoma.
Kansas, State Geological Survey, Bulletin; Oil and Gas Investigation. Lawrence, Kansas.
Kentucky Geological Survey, [Map]. Lexington, Kentucky.
Louisiana Geological Survey, Geological Bulletin; [Maps]. Baton Rouge, Louisiana.
Massachusetts Institute of Technology, MIT Age Studies. Cambridge, Massachusetts.
Michigan, Geological Survey Division, Publication. Lansing, Michigan.
Micropaleontology (American Museum of Natural History). New York.
Mining Engineering (American Institute of Mining, Metallurgical, and Petroleum Engineers). New York.
Missouri, Division of Geological Survey and Water Resources, Report of Investigations. Rolla, Missouri.
Moskovskoe Obshchestvo Ispytatelei Prirody, Byulleten, Otdel Geologicheskii, Moscow.
New Jersey Bureau of Geology and Topography, Atlas Sheet. Trenton, New Jersey.
New Mexico, Bureau of Mines and Mineral Resources, Bulletin; Geologic Maps; Memoir. Socorro, New Mexico.
New York State Museum and Science Service, Geological Survey, [Unpublished Report]. Albany, New York.
North Dakota Geological Survey, Miscellaneous Series; Report of Investigations. Grand Forks, North Dakota.
Ohio, Division of Geological Survey, Report of Investigations. Columbus, Ohio.
Oil in Canada. Winnipeg, Manitoba.
Oklahoma Geological Survey, Bulletin; Circular; Guide Book. Norman, Oklahoma.
Pennsylvania Geological Survey, Atlas; Progress Report; Well-Sample Record. Harrisburg, Pennsylvania.
Photogrammetric Engineering (American Society of Photogrammetry). Washington, D.C.
Research Council of Alberta, Contribution. Edmonton, Alberta.
Research Council of Alberta, Geological Division, Bulletin; Preliminary Report. Edmonton, Alberta.
Rhode Island Development Council, Administrative Report. Providence, Rhode Island.
Saskatchewan, Dept. of Mineral Resources, Regional Structure Contour Map; Report. Regina, Saskatchewan.
Science. Washington, D.C.
Seismological Society of America, Bulletin. Berkeley, California.
South Dakota, State Geological Survey, Geologic Quadrangle Map Series; Oil and Gas Investigations, Map; Report of Investigations. Vermillion, South Dakota.
Stanford University, Publications, Geological Sciences. Stanford, California.
U.S. Geological Survey, Bulletin; Coal Investigations Map; Geophysical Investigations Map; Hydrologic Investigations Atlas; Mineral Investigations Map; Miscellaneous Investigations Map; Oil and Gas Investigations Map; Professional Paper. Washington, D.C.
West Virginia Geological and Economic Survey, Annual Report; Bulletin; [Maps]; [Publications]; State Park Series Bulletin; Volume. Morgantown, West Virginia.

GeoScience Abstracts

1. GEOLOGIC MAPS, AREAL AND REGIONAL GEOLOGY

PART 1. GEOLOGIC MAPS

1-1. Saskatchewan Dept. of Mineral Resources. REGIONAL STRUCTURE CONTOUR MAPS. Petroleum & Nat. Gas Br., Geology Div. [maps], scale 1:506,880, 1958.

E-1	Precambrian Erosion Surface (North Sheet)
E-2	Precambrian Erosion Surface (South Sheet)
E-3	Top of Cambro-Ordovician (North Sheet)
E-4	Top of Cambro-Ordovician (South Sheet)
E-5	Top of Ashern (North Sheet)
E-6	Top of Ashern (South Sheet)
E-8	Top of Nisku Formation (South Sheet & part North Sheet)
E-9	Mississippian Erosion Surface (South Sheet)
E-10	Top of Rierdon Formation (South Sheet)
E-11	Top of Blairmore Formation (North Sheet)
E-12	Top of Blairmore Formation (South Sheet)
E-13	Top of Lower Colorado Group (North Sheet)
E-14	Top of Lower Colorado Group (South Sheet)
E-54	Devonian Erosion Surface (North Sheet)
E-55	Lower Palaeozoic Erosion Surface (North Sheet)
E-56	Lower Palaeozoic Erosion Surface (South Sheet)

These maps indicate structures encountered at various surface horizons and are based entirely on well control, although available seismic data is also taken into account. The maps have been compiled using all information available as of March, 1958, and control wells are indicated on all maps of horizons below the Mississippian. Except in the case of the Precambrian maps in which a 1,000-ft. contour interval has been used, a 100-ft. contour interval has been employed throughout. On the Mississippian Erosion Surface map (E-9) the surface of the Detrital is shown where it overlies Mississippian rocks in the Kindersley and Yorkton areas. In those cases where the strata contoured extend N. beyond township 35, a N. as well as a S. sheet was prepared, as indicated in the above list. --D. R. Francis

1-2. Reade, H. L., Jr., and John C. Scott. PROFILE SHOWING GEOLOGY ALONG U. S. HIGHWAY 331, MONTGOMERY, ALABAMA: Alabama, Geol. Survey, Map 10, 1958.

The geology of exposed rocks along U. S. Highway 331 in Montgomery County is detailed in stratigraphic profile. The formations along the profile include the Mooreville and Demopolis Chalks, Ripley formation, Prairie Bluff Chalk, and Providence sand all of Late Cretaceous age. They strike eastward and dip southward at the rate of 35 to 45 ft. per mi. The rocks exposed along the road cuts are numbered and described according to number in the text on the map. --Auth.

1-3. Arizona Bur. Mines. GEOLOGIC MAP OF YAVAPAI COUNTY, ARIZONA: Univ. Arizona, scale 1:375,000, 1958.

1-4. Wilson, Eldred D., and Richard T. Moore. GEOLOGIC MAP OF GRAHAM AND GREENLEE COUNTIES, ARIZONA: Arizona Bur. Mines, Univ. Arizona, scale 1:375,000, 1958.

1-5. Wilson, Eldred D., Richard T. Moore, and H. W. Peirce. GEOLOGIC MAP OF MARICOPA COUNTY, ARIZONA: Arizona Bur. Mines, Univ. Arizona, scale 1:375,000, 1957.

Compared with the 1924 Geologic Map of Arizona, the County Geologic Maps contain much additional detail and more accurately delineate the geology because of a more accurate base map. A more comprehensive separation of rock units has been made, especially of the volcanic rocks and of the Precambrian crystalline rocks. --Arizona Bur. Mines.

1-6. Wells, J. D. PRELIMINARY GEOLOGIC MAP OF THE HOUSE ROCK SPRING NE QUADRANGLE, COCONINO COUNTY, ARIZ.: U. S. Geol. Survey, Mineral Inv. Map MF-188, scale 1:24,000, contour interval 40 ft., lat. 36°52'30"-37°N., long. 112°-112°07'30"W., 1958.

1-7. Schlocker, J., M. G. Bonilla, and D. H. Radbruch. GEOLOGY OF THE SAN FRANCISCO NORTH QUADRANGLE, CALIFORNIA: U. S. Geol. Survey, Misc. Inv. Map I-272, scale 1:24,000, contour intervals 5 and 25 ft., lat. 37°45'-37°52'30" N., long. 122°22'30"-122°30'W., 1958.

This quadrangle includes part of San Francisco Bay, the N. half of the city of San Francisco, and the southern tip of Marin Peninsula. The bedrock formations are predominantly sandstone, shale, radiolarian chert and altered volcanics, but include some serpentine, gabbro-diabase, and metamorphosed sedimentary rocks of Jurassic and Cretaceous age. The overlying unconsolidated materials of Quaternary age are dune sand, water-laid sand and clay, alluvium, landslide debris, and artificial fill. Engineering properties of the map units are summarized. --U. S. Geol. Survey

1-8. Winterer, E. L., and D. L. Durham. GEOLOGIC MAP OF A PART OF THE VENTURA BASIN, LOS ANGELES COUNTY, CALIF.: U. S. Geol. Survey, Oil & Gas Inv. Map OM-196, scale 1:24,000, 1958.

Six sedimentary formations ranging in age from Eocene to Pleistocene are exposed in the area, which covers about 125 sq. mi. in an important oil-producing region on the N. flank of the Santa Susana Mountains, the W. flank of the San Gabriel Mountains, and part of the Santa Clara Valley in the vicinity of Newhall. These formations, together with the locations of known structural features and locations of wells drilled, are shown on the map, which includes a brief text. --U. S. Geol. Survey

1-9. McQueen, Kathleen. PHOTOGEOLOGIC MAP OF THE IRIS SE AND DOYLEVILLE SW QUADRANGLES, SAGUACHE COUNTY, COLO.: U. S. Geol. Survey, Misc. Inv. Map I-277, scale 1:31,680, lat. 38°15'-38°22'30"N., long. 106°37'30"-106°52'30"W., 1958.

1-10. Wayne, William J. GLACIAL GEOLOGY OF INDIANA: Indiana Geol. Survey, Atlas Mineral Resources Indiana, Map 10, scale 1:1,000,000, 1958.

Boundaries of glacially deposited sediments in Indiana are shown on a new map of the glacial geology of Indiana, published at a scale of 1:1,000,000 (1 in. equals approx. 16 mi.). Nine kinds of glacial materials are shown by colors on a base showing township and range lines, major cities in gray, and drainage in blue.

Most of the moraine boundaries have been revised from earlier maps as a result of studies on modern topographic maps and aerial photographs. Other contacts have been revised to fit more recent information. Units shown on the map are till of 3 glacial ages (Kansan, Illinoian, and Wisconsin), end moraines, ice-contact deposits (gravels in kames, eskers, and pitted outwash plains), gravel and sand in plains and in valleys, sand (dunes), and stratified silts and clays of glacial lakes.

These geologic units, even though generalized, as they must be on a map of this scale, will be a source of useful information to persons who wish data on distribution of gravel resources and other materials in the glacial drift of Indiana. --Auth.

1-11. Hutchison, H. C. GEOLOGY AND COAL DEPOSITS OF THE SEELYVILLE QUADRANGLE, VIGO COUNTY, IND.: U. S. Geol. Survey, Coal Inv. Map C-27, scale 1:24,000, 1958.

Two maps covering 58 sq. mi. in eastern Indiana are printed on one sheet. They show the extent and distribution of bedrock and surficial deposits, distribution, structure, and mined areas of coal. Tables contain data on underground mines, coal reserves, analyses of coal samples, oil and gas test holes, and on thickness and elevation of coal beds and thickness of surficial deposits based upon refraction seismic studies. An explanatory text is included. --U. S. Geol. Survey.

1-12. Goebel, E. D. THE PETROLEUM INDUSTRY IN KANSAS: Kansas, State Geol. Survey, Oil & Gas Inv. 18, scale 1:490,000 (approx.), 1958.

Map shows all oil and gas fields, oil, gas and products pipe lines, refineries, natural gasoline plants, carbon black plants, helium plant, gas storage fields, pump stations, and compressor stations. --Auth.

1-13. Merriam, Daniel F. PRELIMINARY REGIONAL STRUCTURAL CONTOUR MAP ON TOP OF THE STONE CORRAL FORMATION (PERMIAN) IN KANSAS: Kansas, State Geol. Survey, Oil & Gas Inv. 17, scale 1:602,000 (approx.), contour interval 50 ft., 1958.

Map also shows surface and subsurface limit of Stone Corral, area in which the formation could not be identified in well logs, surface and well control points, and oil and gas fields. Area west of Sixth Principal Meridian (Townships 1-43 West), is covered. --Auth.

1-14. Hendrickson, G. E. SUMMARY OF OCCURRENCE OF GROUND WATER IN KENTUCKY: U. S. Geol. Survey, Hydrol. Inv. Atlas HA-10, 3 p., scale 1:750,000, 1958.

Information obtained in cooperative ground-water investigations in Kentucky is summarized. A geologic map of Kentucky and descriptions of ground-water conditions for units shown on it are included. A series of atlases now in preparation will present this information in much greater detail for the 5 ground-water regions of Kentucky. --U. S. Geol. Survey.

1-15. Jones, Daniel J., and Robert E. Hauser. PRELIMINARY OIL AND GAS MAP, GREEN COUNTY, KENTUCKY: Kentucky Geol. Survey, ser. 10, scale 1:48,000, Nov. 1958.

This map was prepared primarily to fill the need for an accurate base map of Green County, and to show the general trend of oil and gas development in the area. The base was adapted from U. S. Geological Survey planimetric sheets. Approximately 750 wells were located on the map; 656 of these are identified as to farm names; elevation and total depth are given where known. --Auth.

1-16. Louisiana Geol. Survey. LOUISIANA SALT DOMES: map, scale 1 in. to 32 mi. (approx.), Jan. 1959.

Map indicates name of salt dome, whether productive of oil and/or gas or non-productive; and location by parish, township and range. --Auth.

1-17. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF EASTERN ROSEAU COUNTY, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-140, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-18. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF WESTERN ROSEAU COUNTY, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-141, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-19. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF KITTSON COUNTY, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-142, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-20. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF EASTERN MARSHALL AND NORTHWESTERN BELTRAMI COUNTIES, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-143, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-21. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF CENTRAL MARSHALL AND WESTERN PENNINGTON COUNTIES, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-144, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-22. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC

MAP OF WESTERN MARSHALL AND NORTHWESTERN POLK COUNTIES, MINN.: U.S. Geol. Survey, Geophys. Inv. Map GP-145, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-23. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF PARTS OF PENNINGTON, RED LAKE, BELTRAMI, CLEARWATER, AND POLK COUNTIES, MINN: U.S. Geol. Survey, Geophys. Inv. Map GP-146, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-24. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF WESTERN RED LAKE AND CENTRAL POLK COUNTIES, MINN.: U.S. Geol. Survey, Geophys. Inv. Map GP-147, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-25. Books, K. G., G. M. Schwartz, J. L. Meuschke, and W. J. Dempsey. AEROMAGNETIC MAP OF WESTERN POLK COUNTY, MINN.: U. S. Geol. Survey, Geophys. Inv. Map GP-148, 2 sheets: sheet 1 (map), scale 1:62,500, contour intervals 50 and 250 gammas; sheet 2 (aeromagnetic profiles), 1958.

1-26. Schmidt, R. G. BEDROCK GEOLOGY OF THE SOUTHWESTERN PART OF THE NORTH RANGE, CUYUNA DISTRICT, MINNESOTA: U. S. Geol. Survey, Mineral Inv. Map MF-181, 3 sheets, scale 1:7,200, geol. cross-secs., strat. column, brief text, 1958.

Mines that have produced iron ore and manganiferous iron ore are shown on 3 detailed geologic maps of 13 sq. mi. This publication is the second of 3 that will include a total of 10 detailed maps of the North Range. Precambrian argillite, slate, quartzite, iron-formation, and volcanic rock underlying the area have been weakly metamorphosed and tightly folded. --U. S. Geol. Survey

1-27. Kummel, H. B., and M. E. Johnson. GEOLOGIC MAP OF NEW JERSEY: New Jersey Bur. Geology & Topography, Atlas Sheet no. 40, scale 1:250,000, rev. 1950.

A geologic map of the entire state showing the outcrop area of Precambrian, Paleozoic, Cretaceous and Tertiary formations. Pleistocene formations are shown by a special overprint. Five cross-sections are shown for various parts of the State. --K. Widmer

1-28. Kuellmer, Frederick J. GEOLOGIC MAP OF HILLSBORO PEAK THIRTY-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 1, scale 1:126,720, 1956.

1-29. Smith, Clay T. GEOLOGIC MAP OF INSCRIPTION ROCK FIFTEEN-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 4, scale 1:48,000, 1958.

1-30. Willard, Max E. RECONNAISSANCE GEOLOGIC MAP OF LUERA SPRING THIRTY-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 2, scale 1:126,720, 1957.

1-31. Willard, Max E. RECONNAISSANCE GEOLOGIC MAP OF PINONVILLE THIRTY-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 3, scale 1:126,720, 1957.

1-32. Willard, Max E., and David B. Givens. RECONNAISSANCE GEOLOGIC MAP OF DATIL THIRTY-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 5, scale 1:126,720, 1958.

1-33. Willard, Max E., and Robert H. Weber. RECONNAISSANCE GEOLOGIC MAP OF CANON LARGO THIRTY-MINUTE QUADRANGLE: New Mexico Bur. Mines & Mineral Resources, Geol. Map 6, scale 1:126,720, 1958.

1-34. Anderson, Sidney B., and Clarence G. Carlson. MADISON SUBCROP-SPEARFISH ISOPACH MAP - BOTTINEAU AREA, NORTH DAKOTA: North Dakota Geol. Survey, Rept. Inv. no. 30, scale 1:158,000 (approx.), columnar sec. with mech. logs, 1 sheet with text, 1958.

This map shows, in color, lithologic units of the Madison group as determined from numerous well studies, with isopach contours of the overlying Spearfish formation. A brief discussion of the basis for division into units is printed on the same sheet. --Auth.

1-35. Geyer, A. R., Carlyle Gray, D. B. McLaughlin, and J. R. Moseley. GEOLOGIC MAP OF THE LEBANON QUADRANGLE, PENNSYLVANIA: Pennsylvania Geol. Survey, 4th ser., Atlas 167 C, scale 1:24,000, columnar sec., cross-secs., text on reverse of map, 1958.

The rocks exposed in the Lebanon quadrangle range in age from late Cambrian to late Triassic. In an effort to map the detailed structure of the Lebanon Valley (Great Valley), it was found that the sequence of limestones and dolomites previously shown as the Conococheague formation could be separated on the basis of lithology alone into 5 members. The authors also found that the sequence of limestones and dolomites previously shown on the State Geologic Map as the Beekmantown limestone could be separated into 4 formations on the same basis.

The regional structural picture of the Great Valley as shown on the State Geologic Map is deceptively simple. When studied in detail, the complexities of the syncline become obvious, and the term synclinorium must be used to describe the regional structures. Even more remarkable, the entire south limb of the synclinorium in the Lebanon Valley appears to be overturned, and to be essentially recumbent. --Auth.

1-36. Collins, Sam G. GEOLOGY OF THE WEWELA QUADRANGLE, SOUTH DAKOTA; South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, columnar sec., text on reverse of map, Sept. 1958.

Bedrock in this part of the Tertiary area of South Dakota includes marine Mobridge(?) and Elk Butte(?) members of the Pierre shale (Cretaceous), overlain by the sandy fluviatile and lacustrine Brule of the White River group (Oligocene) and Valentine and Ash Hollow formations of the Ogallala group (Pliocene). Surficial deposits are Quaternary alluvial and colluvial silt, sand, and gravel. The maximum exposed thickness of the Cretaceous system in this area is 223 ft., and the exposed Tertiary totals 209 ft. Fossils include the cephalopod Baculites from the Elk Butte member; hackberry seeds, and teeth and bones of Pliocene vertebrates. Ground water of good quality is present in the Ash Hollow and Valentine formations, and in the Brule formation. Volcanic ash is present at Turtle Butte. --D. Lum

1-37. Lee, K. Y. GEOLOGY OF THE BROOKINGS QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist mainly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan, Tazewell, and Cary. The drift includes till, outwash, and glacial lake sediments. Recent alluvial deposits occur along the Big Sioux River and its tributaries. The subsurface Cretaceous formations, extrapolated from drillers' logs in adjacent areas, include the Pierre shale, Niobrara chalk, Carlile shale, Greenhorn limestone, and the Dakota group, in descending order.

The outwash deposits of sand and gravel provide an estimated potential water storage capacity of 496,000 acre-ft., with an estimated 192,000 acre-ft. of stored water during the summer of 1957. These deposits also have an estimated reserve of 2,356,000,000 cu. yds. of gravel. --D. Lum

1-38. Lee, K. Y. GEOLOGY OF THE WHITE QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist chiefly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan, Tazewell, and Cary. Recent alluvial deposits occur along the creeks and their tributaries. The subsurface Cretaceous formations, extrapolated from drillers' logs in adjacent areas, include the Pierre shale, Niobrara chalk, Carlile shale, Greenhorn limestone, and the Dakota group [in descending order].

The outwash deposits of sand and gravel provide an estimated potential water storage capacity of 603,000 acre-ft., with an estimated 184,000 acre-ft. of stored water during the summer of 1957. These deposits also have an estimated reserve of 2,405,000,000 cu. yds. of gravel. --D. Lum

1-39. Schoon, Robert A., and William D. Sevon. GEOLOGY OF THE KEYAPAHA QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, columnar sec., text on reverse of map, Sept. 1958.

Bedrock in this part of the Tertiary area of South Dakota includes the upper part of the Pierre shale (Late Cretaceous), overlain by clayey siltstone of the White River group, undifferentiated (Oligocene), and the calcareous sandstone (Pliocene) Valentine and Ash Hollow formations. Surficial deposits include: (1) Quaternary alluvium in present stream valleys, (2) terrace deposits adjacent to these valleys, and (3) wind-blown dune sand at the terrace level. The maximum exposed thickness of the Cretaceous system in this area is 20 ft., and the exposed Tertiary totals 176 ft. Vertebrate fossils are present in the Valentine formation, and fossil hackberry seeds are common in the Ash Hollow. Ground water of good quality is available in the Valentine formation. --D. Lum

1-40. Schoon, Robert A. GEOLOGY OF THE WITTEN QUADRANGLE, SOUTH DAKOTA. South Dakota State Geol. Survey, Geol. Quad, Map Ser., scale 1:62,500, columnar sec., text on reverse of map, Sept. 1958.

Bedrock in this part of the Tertiary area of South Dakota includes, in ascending order, the upper part of the Pierre shale (Cretaceous), the Chadron siliceous clay and Brule silty clay of the White River group (Oligocene), and the Valentine clayey sand and Ash Hollow calcareous sandstone of the Ogallala group (Pliocene). Surficial deposits consist of: (1) Quaternary alluvium in present stream valleys, and (2) terrace deposits adjacent to these valleys. The maximum exposed thickness of the Cretaceous system in this area is 360 ft., and the exposed Tertiary totals 318 ft. Fossil vertebrates and hackberry seeds are common in the Ash Hollow. Ground water of good quality is available in the Valentine formation. Sand and gravel deposits are present, especially along the Keyapaha River valley, and "quartzite" has been quarried at the Red Hills. --D. Lum

1-41. Steece, Fred. V. GEOLOGY OF THE ESTELLINE QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map. Ser., scale 1:62,500, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist chiefly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?), Tazewell, and Cary. Recent alluvial deposits occur in the flood plains of the Big Sioux River and its tributaries. The subsurface Cretaceous formations, extrapolated from drillers' logs in adjacent areas, include, in descending order, the Pierre shale, Niobrara chalk, Carlile shale, Greenhorn limestone, and the Dakota group, which lies unconformably on Precambrian rocks.

Total sand and gravel reserves are estimated at 2,510,000,000 cu. yds., and of this amount 1,610,000,000 cu. yds. contains approximately 297,000 acre ft. of stored water. --D. Lum

1-42. Steece, Fred V. GEOLOGY OF THE HAYTI QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist chiefly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?) Tazewell, and Cary. Recent alluvial deposits occupy the flood plain of the Big Sioux River and the beds of modern lakes. The subsurface Cretaceous formations, extrapolated from drillers' logs in the surrounding area, include, in descending order, the Pierre shale, Niobrara chalk, Carlile shale, Greenhorn limestone, and the Dakota group, which unconformably overlies the Precambrian Sioux formation.

The outwash deposits of sand and gravel contain an estimated 130,000 acre-ft. of stored shallow ground water, and these deposits have an estimated reserve of 2,565,000,000 cu. yds. of sand and gravel. --D. Lum

1-43. Steece, Fred V. GEOLOGY OF THE WATERTOWN QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist chiefly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?), Tazewell, and Cary. Recent alluvial deposits occupy the flood plains of the Big Sioux River and Gravel and Willow creeks. The subsurface Cretaceous formations, extrapolated from drillers' logs in surrounding areas, include, in descending order, the Pierre shale, Niobrara chalk, Carlile shale, Greenhorn limestone, and the Dakota group, which unconformably overlies the Precambrian Sioux formation.

Total sand and gravel reserves are estimated at 3,855,000,000 cu. yds. and of this amount 1,377,200,000 cu. yds.contains approximately 255,000 acre-ft. of stored water. --D. Lum

1-44. Stevenson, Robert E. GEOLOGY OF THE GREGORY QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, columnar sec., text on reverse of map, Sept. 1958.

Bedrock in this part of the Tertiary area of South Dakota includes the marine Elk Butte member of the Pierre shale (Cretaceous), overlain by the sandy fluviatile and lacustrine Brule (?) formation of the White River group (Oligocene), and Valentine and Ash Hollow formations of the Ogallala group (Pliocene). Surficial deposits are the Pleistocene Herrick sands that mantle the uplands, and Quaternary alluvial deposits in present stream valleys. The maximum exposed thickness of the Cretaceous system in this area is 176 ft., and the exposed Tertiary totals 160 ft. Vertebrate fossils are present in the Valentine and Ash Hollow formations. Ground water of good quality is present in the Valentine formation. Sand is available in the Herrick formation. --D. Lum

1-45. Tipton, Merlin J. GEOLOGY OF THE FLORENCE QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, incl. index map of phys. divs., former drainage channels, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist mainly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?), Tazewell (?), and Cary. The drift includes till, outwash, and lake deposits. Recent alluvial deposits, confined to lakes, were not mapped. Subsurface information is sparse, but Cretaceous rocks are inferred beneath the drift, and unconformably below them are Precambrian rocks.

The major economic resources include shallow ground water, sand and gravel. Collapsed outwash deposits limit the amount of water available for irrigation, although sufficient ground water is present for domestic purposes. --D. Lum

1-46. Tipton, Merlin J. GEOLOGY OF THE HENRY QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, incl. index map of phys. divs., former drainage channels, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist mainly of Pleistocene Wisconsin glacial drift in which 2 subdivisions are recognized: Iowan(?) and Cary. The drift includes till, outwash, and eskers. Recent alluvial deposits, confined to lakes, were not mapped. Subsurface information is sparse, but Cretaceous rocks are inferred beneath the drift, and unconformably below them are Precambrian rocks.

The major economic resources include shallow ground water, sand and gravel. Collapsed outwash deposits limit the amount of water available for irrigation, although sufficient ground water is present for domestic purposes. --D. Lum

1-47. Tipton, Merlin J. GEOLOGY OF THE SOUTH SHORE QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, incl. index map of phys. divs., former drainage channels, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist chiefly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?), Tazewell (?), and Cary. Recent alluvial deposits, confined to present lakes, were not mapped. Subsurface information is lacking except for one oil test well which penetrated, in descending order, the Cretaceous Carlile shale, Greenhorn limestone, Graneros shale, and the Dakota group, above the Precambrian "granite."

The outwash sand and gravel deposits are estimated to contain 1,100,000,000 cu. yds. of gravel, of which potential areas for ground-water storage cover 14,000 acres and contain 560,000 acre-ft. of water. Because of limited recharge, the shallow resources are insufficient for large-scale irrigation. --D. Lum

1-48. Tipton, Merlin J. GEOLOGY OF THE STILL LAKE QUADRANGLE, SOUTH DAKOTA: South Dakota State Geol. Survey, Geol. Quad. Map Ser., scale 1:62,500, incl. index map of phys. divs., former drainage channels, text on reverse of map, Sept. 1958.

The surficial deposits in this part of the Big Sioux River area of South Dakota consist mainly of Pleistocene Wisconsin glacial drift in which 3 subdivisions are recognized: Iowan(?), Tazewell(?), and Cary. The drift includes till, outwash, and lake deposits. Recent alluvial deposits occur in the valleys of the Big Sioux River and its tributaries.

Subsurface information is sparse, but Cretaceous rocks are inferred below the drift, and unconformably below them are Precambrian rocks (based on information in adjacent areas).

The major economic resources include shallow ground water, sand and gravel. Total sand and gravel resources are estimated at 1,700,000,000 cu. yds., and stored ground water is estimated at 800,000 acre-ft. --D. Lum

1-49. Petsch, Bruno C. MAGNETOMETER MAP OF HARDING AND PERKINS COUNTIES, SOUTH DAKOTA: South Dakota State Geol. Survey, Oil & Gas Inv., Map 2, scale 1:220,000 (approx.), structure map, cross-secs., text on reverse of map, Sept. 1958.

The map shows vertical magnetic anomalies with a contour interval of 50 gammas. The major anomaly in Harding County is an 8-mi. wide magnetic high that extends generally N.-S. for 100 mi. In Perkins County a smooth magnetic slope increases in intensity toward the E., flanking a large magnetic high in the eastern part of the county. Some of the anomalies seem to coincide with structural features. --D. Lum

1-50. Agnew, Allen F. OIL AND GAS TESTS IN SOUTH DAKOTA, 1957: South Dakota State Geol. Survey, Oil & Gas Inv., Map 1, scale 1:1,000,000, text on reverse of map, Aug. 1958.

The map shows location of producing wells, dry holes, oil shows, and gas shows, all with total depths. Forty-four test wells totaling 156,491 ft. of drilling were completed during 1957, mostly in the Williston Basin and the Black Hills fringe. On the back of the map, electric log and sample tops are tabulated for all 44 tests. --D. Lum

1-51. McIntosh, W. L. PHOTOGEOLOGIC MAP OF THE COCKSCOMB SE QUADRANGLE, KANE COUNTY, UTAH: U. S. Geol. Survey, Misc. Inv. Map I-275, scale 1:24,000, lat. 37°15'-37°22'30"N., long. 111°45'-111°52'30"W., 1958.

1-52. Haught, Oscar L. MAP OF WIRT, ROANE, AND CALHOUN COUNTIES, SHOWING OIL AND GAS FIELDS, STRUCTURAL CONTOURS ON TOP OF GREENBRIER LIMESTONE: West Virginia Geol. & Econ. Survey, scale 1:62,500, 1958.

This map shows and gives the names of all productive areas and of structural features. It also shows all known well locations, and indicates the result and present status of each well, insofar as such information is available. --Auth.

1-53. Price, Paul H. MINERAL RESOURCES AND MINERAL INDUSTRIES OF WEST VIRGINIA: West Virginia Geol. & Econ. Survey, scale 1:500,000, 1958.

Map shows areal distribution of coal, gas, oil, limestone, rock salt, gas storage fields, principal pipe lines, etc.; also locations of coal mines, rock quarries, gravel pits, etc. It is intended primarily for school room use. --Auth.

PART 2. AREAL AND REGIONAL GEOLOGY

See also: Geomorphology 1-72; Stratigraphy 1-94, 1-95; Geohydrology 1-238, 1-240; Mineral Deposits 1-260.

1-54. Kirkland, S. J. T. THE GEOLOGY OF THE DESCHAMBAULT LAKE AREA (EAST HALF), SASKATCHEWAN: Saskatchewan Dept. Mineral Resources, Rept. no. 31, 18 p., geol. map, scale 1:63,360, 1958.

The report deals with a 15' quadrangle in the southern Precambrian shield area of Saskatchewan. All consolidated rocks are of Precambrian age and include metamorphic rocks of volcanic and sedimentary origin with early basic intrusives, intruded later by granodiorites and pegmatites. Axes of folds trend in a general N.-S. direction, and one major fault, which is recognized as part of a regional structure more than 100 mi. in length, trends NW. across the area. Traces of mineralization of 2 types were observed: disseminated graphite-pyrite zones in augen gneiss and biotite migmatite, and pyrrhotite-pyrite dissemination in calc-silicate and hornblendic rocks. --R. L. Cheesman

1-55. Miller, J. D., Jr., and L. V. Causey. GEOLOGY AND GROUND WATER RESOURCES OF TUSCALOOSA COUNTY, ALABAMA, AN INTERIM REPORT: Alabama, Geol. Survey, Inf. Ser. 14, 69 p., 2 geol. cross-secs., 1958.

Tuscaloosa County, in W.-central Alabama, occupies parts of 5 physiographic divisions. The county may be divided into nearly equal parts by a diagonal line from the SE. to the NW. corners, roughly tracing the Fall Line. The northeastern half of the county, except for about 50 sq. mi. in the SE. corner in the Ridge and Valley province, is in the Cumberland Plateau section of the Appalachian Plateaus province and is characterized by steeply eroded hills and plateaus. The southwestern half of the county is in the Coastal Plain province and includes parts of 3 physiographic divisions - the Fall Line Hills section and the relatively flat terraces and flood plains along the Sipsey and Black Warrior rivers and their tributaries.

Tuscaloosa County is underlain by strata of limestone, dolomite, sandstone, shale, coal, gravel, sand and clay, ranging in age from Cambrian to Quaternary. In the southeastern part of the county are outcrops of limestone, dolomite, sandstone, and shale, ranging in age from Cambrian to Pennsylvanian. Solutionally enlarged openings in the dolomite are an important source of ground water. Wells yielding as much as 220 gpm. (gallons per minute) and springs flowing as much as 7,360 gpm. indicate the productiveness of these rocks in some places. In the northeastern part of the county the Pottsville formation consists mainly of beds of sandstone, shale and coal which dip gently SW. 30 to 40 ft. per mile and supply small quantities of water, generally less than 10 gpm. but sometimes as much as 100 gpm., to wells intersecting fracture and bedding-plane openings. In the southwestern half of the county, permeable sand and gravel beds of Late Cretaceous and Recent age are important sources of ground water, some wells yielding as much as 1,000 gpm. --Auth.

1-56. Mueller, Paul M. **GEOLOGY OF CROSS MOUNTAIN, COLORADO, NORTH OF THE YAMPA RIVER: Compass, v. 36, no. 1, p. 2-22, 5 figs. incl. geol. map, secs., Nov. 1958.**

Cross Mountain is an elongate, faulted anticline which rises from relatively flat country near the town of Lily, in northwestern Colorado. The anomalous orientation of this structure with respect to the adjacent Uinta Range has made Cross Mountain subject to speculation by various writers regarding this relationship and concerning its geologic history. There has been considerable controversy, also, about the origin of the canyon of the Yampa River at Cross Mountain.

The history of the immediate Cross Mountain area can be traced back to late Precambrian time when a large, east-west trending depositional trough was formed in the zone that is now occupied by the Uinta Range. As this trough subsided it was filled with about 25,000 ft. of Precambrian, Paleozoic, and Mesozoic sediments. Near the end of the Cretaceous period or early in the Tertiary, Laramide forces transformed the trough into a large simple anticline - the Uinta Anticline. As these forces waned, others from the west became dominant, producing a northeasterly force component. This component is believed responsible for the folding of the Cross Mountain Anticline. The ensuing period of erosion was interrupted by rotational faulting along the flanks of the Cross Mountain Anticline (probably at the end of the Eocene), uplifting the central part. This, in turn was followed by extensive erosion which culminated in the Oligocene (?) Gilbert Peak erosion surface of the eastern Uinta area. Upon this surface the Bishop conglomerate was deposited, perhaps in the Miocene time. Renewed activity along the flanking faults once again raised the central mountain block and subjected it to intensified erosion. At this time the structure was carved into essentially the same mountain as we see today. The Miocene (?) Browns Park formation then was deposited in the eastern Uinta area and buried most or all of the mountain. The Yampa and Little Snake rivers were developed on the Browns Park surface and were subsequently superposed on the underlying Cross Mountain structure. As the Browns Park sands were removed, these streams cut deep into the hard underlying rocks. Cross Mountain is thus a "fossil" mountain in the process of being exhumed by the Yampa River and its tributaries. --Auth.

1-57. Ross, Clyde P., and J. Donald Forrester. **OUTLINE OF THE GEOLOGY OF IDAHO: Idaho Bur. Mines & Geology, Bull. 15, 74 p., 5 illus., 3 charts, 2 maps (in pocket), May 1958, 87 refs.**

This bulletin gives a summary of present concepts of the geology of Idaho, intended as a background for anyone interested in any phase of the subject. [It is designed as an explanatory text for the Geologic Map of Idaho, scale 1:500,000].

The Precambrian rocks of Idaho include stratified sediments, metamorphic masses, and basic igneous intrusive rocks. Marine sedimentation, volcanism, and local glaciation were dominant in the Proterozoic, with widespread crustal movements occurring near the close of the era.

Marine sedimentation continued throughout the Paleozoic; sedimentary rocks representing each Paleozoic period occur within the State. Minor igneous activity and gentle undulatory movements that neither crumpled nor broke the crust occurred in the late Paleozoic.

Marine deposition continued in parts of Idaho during the Mesozoic era, but was overshadowed in most areas by large-scale igneous activity and crustal movements. The Idaho batholith and related bodies were emplaced in late Mesozoic time.

Many of the Cenozoic rocks of Idaho are lava flows and other products of volcanism. These extrusives are interbedded with and overlain by lake and stream deposits. Granitoid masses and related dike zones of Tertiary age have been mapped in several parts of Idaho. Erosion was dominant during early Cenozoic time, and much of Idaho was reduced to a level region with only remnants of former mountain ranges remaining.

The mineral resources of Idaho are directly related to its geology. Mining districts are distributed throughout the State, and a total of 58 mineral commodities are extracted.

Mineralization has occurred in Idaho at intervals from the Proterozoic to Recent times. Most of the lode deposits were formed in 2 metallogenetic epochs, one during the emplacement of the Idaho batholith, and the other during Tertiary time.

Placer deposits are common in many parts of the State, but mining operations are limited to gold and monazite production.

Industrial minerals are abundant but lack of market has retarded their development. Deposits of the mineral fuels are known but production has been small. -- K.M. Hollenbaugh

1-58. Savage, C. N. **GEOLOGY AND MINERAL RESOURCES OF ADA AND CANYON COUNTIES: Idaho Bur. Mines & Geology, County Rept. 3, 94 p., 21 illus., 8 maps (2 in pocket), scale 1 in. to 2 mi., Oct. 1958, 52 refs.**

The oldest rocks in Ada and Canyon counties, Idaho, are Cretaceous granodiorite, quartz monzonite, pegmatite, and rhyolite. Columbia River and Snake River eruptives represent several episodes of Tertiary and Quaternary volcanism. All sedimentary rocks in the area are of Cenozoic age and of fluviatile and lucustrine origin.

The tectonic history of the region has included subsidence of marine troughs in Precambrian and Paleozoic times and the development of arcuate belts of weakness during Nevadan and Laramide orogenies which provided access for the emplacement of the Idaho batholith. In Cenozoic time the area was intermittently uplifted, faulted, and eroded. Pleistocene and post-Pleistocene variations in precipitation produced numerous prominent erosional and depositional surface features.

Mineral resources in the region are limited. Gold in placer and lode deposits is the only metallic mineral of economic value; it is found and produced in relatively small quantities.

The most abundant mineral resources are sand, gravel, and water. An abundant water supply promoted the early settlement of the area; the water is now used for irrigation, hydroelectric power, and domestic purposes. Other nonmetallic commodities produced in small quantities include volcanic cinders, silica sand, diatomite and dimension stone. Expansion of silica sand production and other available non-metallic minerals is foreseen.

Ada and Canyon counties offer a suitable environment for the growth of new industry and particularly the chemical industries. Labor and technical personnel, power, transportation facilities, and raw materials are readily available. --K. M. Hollenbaugh

1-59. Welch, Stewart W. GEOLOGY AND COAL RESOURCES OF THE TIPTOP QUADRANGLE, KENTUCKY: U. S. Geol. Survey, Bull. 1042-P, p. 585-612, figs. 51-58, pls. 50-55, geol. map, scale 1:24,000, Nov. 1958.

The Tiptop 7 1/2-min. quadrangle in the eastern Kentucky coalfield, covers about 59 sq. mi. in Breathitt, Magoffin, and Knott counties. The bedrock cropping out at the surface and extending to a depth of about 200 ft. below drainage, as described herein, is assigned to the Breathitt formation of Pennsylvanian age. The Breathitt formation consists primarily of sandstone, siltstone, and shale, and of minor amounts of limestone, chert, underclay, and coal. Sandstone, the dominant rock type, occurs in beds ranging from less than one foot to more than 100 ft. in thickness. Chert, the least common rock type, occurs locally as thin beds at a few stratigraphic positions. The most extensive beds are the coals and some of the marine shales and limestones.

The Big Caney syncline, which trends westward across the northern part of the Tiptop quadrangle, is the dominant structural feature. The strata dip gently toward the axis of this syncline, but the general dip is reversed along several small westward-trending anticlines, or steepened, as, for example, along the Lambric fault. The Lambric fault extends westward from the N.-central part of the quadrangle to the western edge, where its vertical displacement is a maximum of 160 ft. The fault is mapped here for the first time.

Reserves of coal were computed for 9 coal beds: the Tom Cooper, Gun Creek, Fire Clay Rider, lower Haddix, upper Haddix, Prater, Oakley, Fugate, and Skyline. Of these, only the Skyline bed has been mined extensively. The coal is of high volatile A and B bituminous ranks. The estimated coal content of beds more than 14 in. thick is 535 million tons, of which about half is recoverable. --Auth.

1-60. Trites, Albert F., Jr., and Ralph H. Thurston. GEOLOGY OF MAJUBA HILL, PERSHING COUNTY, NEVADA: U. S. Geol. Survey, Bull. 1046-I, p. 183-203, fig., pls. 7-11, geol. map, scale 1 in. to 1,000 ft., Oct. 1958.

Majuba Hill is a complex plug of rhyolitic rocks of Tertiary(?) age in the central part of the Antelope Range. The plug intrudes sedimentary rocks of Triassic(?) age, which consist chiefly of argillite with smaller amounts of quartzite and impure limestone. It is about 5,000 ft. in diameter and has apophyses that extend beyond its margin. The rhyolitic rocks are of 3 varieties that are here called earlier rhyolite, rhyolite porphyry, and later rhyolite. Five main varieties of intrusive breccia occur in dikes and irregular masses cutting the older rhyolitic rocks. The rhyolitic rocks of the plug and the intruded sedimentary rocks have been silicified, sericitized and tourmalinized.

Three principal pre-ore faults are exposed in the Majuba Hill mine. The largest of these, the Majuba fault, strikes N. 30° W., dips 54°-84° SW., and has a displacement of about 155 ft.

Cu and Sn are the principal ore metals at Majuba Hill. From 1916 to 1949 slightly more than 27,000 tons of Cu ore was produced from the Majuba Hill mine. About 350 tons of Sn ore also has been shipped from this mine, and small quantities of Pb-Ag and As-Ag ore have been produced from properties nearby. U is locally associated with the Cu and Sn deposits in the Majuba Hill mine but has not been mined. --Auth.

1-61. Russell, Dearl T. GUIDE TO ROBBERS CAVE STATE PARK AND CAMP TOM HALE, LATIMER COUNTY, OKLAHOMA: Oklahoma Geol. Survey, Guide Book 7, 23 p., 12 figs., 2 pls., incl. illus., geol. map, block diags., 1958.

Guide to the geology, botany and zoology of an area of 13 sq. mi., written to appeal to youth groups and laymen. --Auth.

1-62. Lee, K. Y. GEOLOGY AND SHALLOW GROUND WATER RESOURCES OF THE BROOKINGS AREA, BROOKINGS COUNTY, SOUTH DAKOTA: South Dakota State Geol. Survey, Rept. Inv. 84, 62 p., 8 illus. (3 col.), Sept. 1958.

The surficial deposits of the Brookings area comprise chiefly drift of 3 subdivisions of the Wisconsin, the Iowan, Tazewell, and Cary. The pebble fractions of the Iowan and Tazewell tills have only slight differences in percentages of the different rock types, but the Tazewell till is comparatively less oxidized, and somewhat fissile and blocky. The Cary drift is characterized by a remarkable end moraine, a distinctive lithologic composition, and by less leaching than the Iowan and Tazewell.

Outwash deposits of sand and gravel are ideal water-bearing sediments, and are good material for road and building construction. The quantity of sand and gravel is about 4,734,000,000 cu. yds., of which 30% is in the Big Sioux Valley. The total storage capacity of shallow ground water in the outwash deposits is approximately 1,066,000 acre-ft., and the Big Sioux outwash occupies 30%. The amount of ground water in the outwash deposits during the summer of 1957 was about 364,000 acre-ft, 40% of which was stored in the Big Sioux outwash. This ground water is generally satisfactory for human consumption, but water derived directly from sand lenses in the glacial tills is high in nitrate, sulfate, and iron. --Auth.

1-63. Steece, Fred V. GEOLOGY AND SHALLOW GROUND WATER RESOURCES OF THE WATERTOWN-ESTELLINE AREA, SOUTH DAKOTA: South Dakota State Geol. Survey, Rept. Inv. 85, 38 p., 8 illus. (1 col.), Sept. 1958.

The Watertown-Estelline area is in northeastern South Dakota in the N.-central part of the Coteau des Praires of the Central Lowlands Physiographic Province. The area occupies about 650 sq. mi. and is drained by the Big Sioux River.

Precambrian granite and metamorphic rocks underlie the entire area and are overlain in part of the area by the Sioux formation, also of Precambrian age. About 900 to 1000 ft. of Cretaceous sedimentary rocks overlie the basement; in ascending order, these are the Dakota group, and the Graneros, Greenhorn, Carlile, Niobrara, and Pierre formations. Mantling the bedrock are glacial deposits of Pleistocene age. The Wisconsin stage is represented by Iowan(?), Tazewell, and Cary drifts.

Shallow ground water is stored in the glacial outwash sands and gravels. The principal source of recharge is precipitation, and the major discharge is through wells and through evaporation and transpiration by plants. The calculated water resources of the area are about 270 billion gals. The volume of sand and gravel in the glacial deposits is 7 3/4 billion cu. yds.

In general, recharge exceeds discharge in the gravels, and the movement of the ground water is southward. The quality of water for irrigation is good to excellent, and thus the future of irrigation and/or industrial use of water in the Watertown-Estelline area is favorable. --Auth.

1-64. Snavely, Parke D., Jr., R. D. Brown, Jr., Albert E. Roberts, and W. W. Rau. GEOLOGY AND COAL RESOURCES OF THE CENTRALIA-CHEHALIS DISTRICT, WASHINGTON: U. S. Geol. Survey, Bull. 1053, 159 p., 25 figs., 13 pls.,chart, geol. map, scale 1:48,000, Nov. 1958.

The Centralia-Chehalis coal district includes about 570 sq. mi. in southwestern Thurston County and northwestern Lewis County, midway between Seattle, Wash., and Portland, Oreg., and forms a part of the subbituminous and lignite coal fields of southwestern Wash. It adjoins the Morton coal field on the E. and the Toledo coal field on the S. It includes a part of the extreme western foothills of the Cascade Range and a part of the eastern border of the Coast Ranges.

The consolidated stratified rocks exposed at the surface are: a sequence of poorly consolidated nonmarine sedimentary rocks of Pliocene(?) and Miocene age; the Columbia River(?) basalt and Astoria(?) formation of Miocene age; the Lincoln formation of Oligocene age; the coal-bearing Skookumchuck and the Northcraft formations of late Eocene age; and the McIntosh formation of late and middle Eocene age. This sequence of Tertiary rocks consists of interbedded siltstone, sandstone, and conglomerate; some coal beds; and associated volcanic rocks with basalt and gabbro intrusive rocks. The total thickness of these rock units in the district is more than 12,000 ft. Unconformities are present, locally at the base of the Skookumchuck formation, at the base of the Astoria(?) formation, and at the base of the Columbia River(?) basalt. The contacts between the other rock units are probably conformable. Overlying the Tertiary rocks in parts of the district are poorly consolidated gravel, sand, silt, and clay of the Logan Hill formation of early Pleistocene age and Vashon drift of late Pleistocene age. Other unconsolidated deposits include sand and gravel of stream terraces, landslide debris, and alluvium.

The dip of the beds in the Centralia-Chehalis district ranges from 0° to 90°. Most of the major structural elements have a northwesterly trend, but a few faults trend westward. A large structurally complex anticlinal fold, known as the Lincoln Creek uplift, is in the western part of the area. This fold is bounded on the N. by the northwestward-trending Centralia syncline and on the south by the Chehalis River syncline. Except for the Tenino and Crawford Mountain anticlines and the shallow Tono basin, the folds in the eastern half of the area are narrow and asymmetric, and faults are present along the former axes of some of the anticlines.

The principal faults in the area are the westward-trending Doty, Salzer Creek, and Chehalis faults, and the northwestward-trending Scammon Creek, Kopiah, China Creek, Newaukum, and Coal Creek faults. Except for the Chehalis, Saltzer Creek, and Scammon Creek normal faults, all are high-angle reverse(?) faults downthrown to the S. or SW.

At least 13 different coal beds have been mined in the district. The coal beds range in thickness from a few inches to 40 ft. and have an average thickness of 6 to 8 ft. Most of the minable coal is subbituminous C in rank, has a moisture content ranging from 14 to 35%, and an ash content ranging from about 5 to 25%. Its heating value varies from 6,700 to 9,880 B.t.u. The coal slacks readily when exposed to the air because of its high moisture content. According to estimates made by the authors, the district contains more than 3 1/2 billion tons of coal, of which about 40% is considered recoverable with present mining methods. Nearly 15,000 ft. of drilling was done from 1949 to 1951 to obtain information on the extent, thickness, physical characteristics, and reserves of coal. During 1951, 4 mines were operating in the area and produced a total of 52,500 tons of coal.

Fourteen test holes for oil and gas have been drilled within the area from Jan. 1901 to July 1952, but the results of this drilling have not been encouraging and only small shows of gas have been reported. The McIntosh formation, which includes a thick sequence of marine siltstone with interbedded sandstone, is considered the most favorable formation to test for oil and gas. --Auth.

Includes: Section on microscopical character of Centralia-Chehalis coal, by J. M. Schopf.

1-65. Ludlum, John C. RESOURCES, GEOLOGY AND RECREATION AT BLACKWATER FALLS STATE PARK, WEST VIRGINIA: West Virginia Geol. & Econ. Survey, State Park Ser. Bull. no. 6 (prelim.), 39 p., 8 illus., 2 pls. incl. diag. secs., 2 maps, 1958.

The main value of the park area has hitherto been for lumbering and coal-mining, but present and prospective value is as a recreation area.

A historical summary of settlement and economic development is given, followed by discussion of possible presence of oil or gas in paying amounts, and of available water power. Structure and topography of the area are then discussed, and the course of development of the present-day landscape is described. The bulletin ends with a description of scenery and geology to be found between Blackwater Falls Park and the Mouth of Seneca, 36 mi. by road to the SE. --Auth.

2. GEOMORPHOLOGY

See also: Geologic Maps 1-10.

1-66. Howard, Arthur David. NUMERICAL SYSTEMS OF TERRACE NOMENCLATURE, A CRITIQUE: Jour. Geology, v. 67, no. 1, p. 109-12, Jan. 1959.

Numerical systems of terrace nomenclature have basic defects which tend toward confusion in correlation and may lead to erroneous interpretations of regional history. A binomial system of nomenclature, similar to that used in the naming of stratigraphic formations, is recommended. --Auth.

1-67. Frye, John C. CLIMATE AND LESTER KING'S "UNIFORMITARIAN NATURE OF HILL-

SLOPES": Jour. Geology, v. 67, no. 1, p. 113-16, Jan. 1959.

In Lester King's recent provocative discussion of hillslope genesis it is contended that basic physical controls on landscape remain the same in all climatic environments short of the frigid or extremely arid. Examples from 3 regions of sharply contrasting climate in the United States suggest that climatic factors play a significant role in determining the relation of the slope elements to one another and to the rate of development during the progress of the erosion cycle. --Auth.

1-68. Langbein, W. B., and S. A. Schumm. YIELD OF SEDIMENT IN RELATION TO MEAN ANNUAL PRECIPITATION: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1076-84, 8 figs., Dec. 1958.

Effective mean annual precipitation is related to sediment yield from drainage basins throughout the climatic regions of the United States. Sediment yield is [at] a maximum at about 10 to 14 in. of precipitation, decreasing sharply on both sides of this maximum, in one case owing to a deficiency of runoff and in the other to increased density of vegetation. Data are presented illustrating the increase in bulk density of vegetation with increased annual precipitation and the relation of relative erosion to vegetative density.

It is suggested that the effect of a climatic change on sediment yield depends not only upon direction of climate change, but also on the climate before the change. Sediment concentration in runoff is shown to increase with decreased annual precipitation, suggesting further that a decrease in precipitation will cause stream channel aggradation. --Auth.

1-69. Epstein, Samuel, and Robert P. Sharp. OXYGEN-ISOTOPE VARIATIONS IN THE MALASPINA AND SASKATCHEWAN GLACIERS: Jour. Geology, v. 67, no. 1, p. 86-100, 8 figs., incl. maps, columnar secs., Jan. 1959.

Oxygen-isotope analyses of ice and firn from the Saskatchewan Glacier [Banff National Park, Alberta], Canada, and the Malaspina Glacier [St. Elias Mts.], Alaska, show that variations in O^{18}/O^{16} ratios are likely to be of considerable value in glaciological research. The general trend of O^{18}/O^{16} ratios in ice along the center flow line of Saskatchewan Glacier is a decrease from firn limit to terminus. This is interpreted as indicating that ice at successively lower points in the glacier tongue originated at progressively higher positions in the accumulation area, thus confirming Reid's early deductions concerning flow lines in a valley glacier. Ice in the glacier tongue has a higher average O^{18}/O^{16} ratio than the 1953-1954 layer of firn in the accumulation area. This may be due to the fact that meltwater relatively rich in O^{18} percolating down from the surface has refrozen in the deeper firn, or it may possibly indicate a change to cooler climatic conditions within the last few hundred years. Ice samples from a transverse profile across Saskatchewan Glacier have higher O^{18}/O^{16} ratios near the center than near the margins. This occurs because the marginal ice comes from a higher altitude in the accumulation area.

Separate strata within Saskatchewan firn display large differences in oxygen-isotope ratios which are preserved to some degree in the ice tongue and may be useful in the identification of vestigial sedimentary layering. However, a high degree of homogenization can occur by the time the ice reaches the lower part of the glacier, as shown by a series of closely spaced samples of well-foliated ice with remarkably consistent oxygen-isotope ratios.

In Malaspina Glacier, the oxygen-isotope ratios confirm a deduction made earlier as to the principal units composing this piedmont sheet. Ice that originates in the upper Seward Basin has a higher O^{18}/O^{16} ratio than material supplied from higher mountain slopes bounding that basin. Oxygen-isotope data also confirm an earlier interpretation to the effect that the intensely deformed and greatly thinned bands of ice in the outer part of Malaspina Glacier represent individual valley glaciers separated by medial moraines. --Auth.

1-70. Gravenor, C. P., and W. A. Meneley. GLACIAL FLUTINGS IN CENTRAL AND NORTHERN ALBERTA: Am. Jour. Sci., v. 256, no. 10, p. 715-28, illus., maps, Dec. 1958.

An examination of vertical air photographs covering about 175,000 sq. mi. of northern and central Alberta has revealed the presence of large fields of glacial flutings. The flutings show 2 dominant trends, one in a south to southwest direction and the other in a southeast direction. Although the majority of the flutings are formed in till, in northeastern Alberta the flutings are erosional in character and developed in Precambrian granite gneiss. Striae on the Precambrian flutings are roughly parallel to the ridges. Till fabric determinations made on the southeast flutings of the North Battleford, Saskatchewan district show that there is a marked change in fabric with depth in the ridges. Fluting development apparently bears little relationship to topography. It is believed that the flutings originated from alternating high and low pressure zones at the base of the ice. --Auth.

1-71. Gravenor, C. P., and W. O. Kupsch. ICE-DISINTEGRATION FEATURES IN WESTERN CANADA: Jour. Geology, v. 67, no. 1, p. 46-62, 4 figs., incl. map, 6 pls., Jan. 1959, 29 refs.

The wasting Wisconsin glacier left predominantly till deposits in western Canada and only subordinate amounts of stratified drift. In the final phases of wasting, the ice separated in places into a large number of small, dead, ice blocks: it disintegrated. This disintegration caused the preservation of many different land forms, some of which were initiated during the time of ice flow; others originated after flow ceased. Those features that show the influence of the previous live ice are said to be "controlled." Such control may be exerted by crevasses and thrust planes which are the response to stresses operative in a living glacier. Uncontrolled deposits do not reveal the influence of former flow. All gradations between controlled and uncontrolled disintegration can be observed.

The depositional disintegration features include hummocks, moraine plateaus, round and irregularly shaped closed ridges, linear ridges, and washboard moraines. Ice-walled channels are an erosional form. The hummocky terrain and the closed ridges are regarded as the dominant product of uncontrolled disintegration. The linear and washboard ridges developed along inherited lines of weakness in the disintegrating ice and are regarded as controlled disintegration features.

Both uncontrolled and controlled deposits resulted from the sloughing of ablation material into cracks and cavities in the ice and from the squeezing of till upward into openings at the base of the ice. --Auth.

1-72. Flint, Richard Foster, and Charles S. Denny. QUATERNARY GEOLOGY OF BOULDER MOUNTAIN, AQUARIUS PLATEAU, UTAH: U. S. Geol. Survey, Bull. 1061-D, p. 103-64, figs. 24-30, pls. 6-8, surficial geol. map, scale 1:63,360, Nov. 1958.

Boulder Mountain, the northeastern part of the Aquarius Plateau, exceeds 11,000 ft. in altitude; it is the highest of the High Plateaus of Utah. The mountain has a nearly flat summit area of about 70 sq. mi. and possesses steep side slopes.

During late Pleistocene time an icecap formed repeatedly on top of the mountain, covering most and possibly all of it. The ice drained off the top through broad canyon-like troughs in the plateau sides. During the most extensive glaciation (Bull Lake? stage), the termini of these outlet glaciers reached down to altitudes as low as 6,600 ft. During the later Pinedale(?), stage, the outlet glaciers followed nearly the same paths but were much less extensive. Glaciation of the plateau top is shown mainly by radial grooving, striation, and shaping of bedrock features. Glaciation of the plateau sides is recorded by lobes of glacial drift having morainic topography.

Two sets of conspicuous moraines are identified in Pinedale(?) drift. After Pinedale(?) glaciation ended, rock glaciers were built around the base of the cliff that bounds the summit of the plateau. The rock glaciers probably originated mainly as local drift deposited by ordinary glaciers of small size, and therefore record an episode of cold wet (Temple Lake? stage of Howard and Hack) climate. Talus overlying the rock glaciers is attributed to a later and less rigorous cold wet episode.

The drift bodies are correlated on a basis of degree of weathering of component material, modification of the topography by surface agencies, and relative vertical positions of drift-lobe termini.

The kinds of soil developed on the successive sheets of glacial drift are not sufficiently well defined to aid in correlating the drift sheets. No undoubted drift of pre-Sangamon age was found, and no soil of Sangamon or older date was positively identified, although some of the weathered mantle in the district probably dates from Sangamon (pre-Bull Lake?) time.

At the base of the plateau at various altitudes are dissected pediments veneered with bouldery deposits. Most of the pediments are believed to have been formed in Sangamon or older time; the sediments that cover them are not believed to be glacial outwash.

In the valley of the Fremont River, which skirts the northern base of the plateau, sections of alluvium record 2 episodes of filling separated by an episode of erosion. Eolian(?) sand and flaggy colluvium were deposited in the Torrey-Teasdale lowlands during Pinedale and later times.

The most noticeable and widespread deposits on the sides of the plateau are landslides. These deposits mask the bedrock extensively and include not only a widespread veneer of material that has slumped and flowed down the slopes but also large complex tongue-like landslides as much as 4 mi. in individual length. The slides are of several dates; in places sliding is in progress at present. --Auth.

1-73. Serayev, N. A. OZERO STERZH [STERZH LAKE]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 164, 1958.

Resume of lecture given March 24, 1958. A new bathymetric map (scale 1:50,000), based on measurements made in 1956, was prepared by the author. The data obtained are shown in a table. The morphological data obtained in 1894-1898 by D. N. Anuchin establish by comparison the changes in the basin of the lake, silting, changes in surface water discharge in connection with deforestation, and other changes which occurred during the past 60 years. --LC

1-74. Davies, William E. CAVERNS OF WEST VIRGINIA: West Virginia Geol. & Econ. Survey, Vol. 19-A, 350 p., illus., maps, 1958.

A revised edition of a work first published in 1949. It contains descriptions, location data, plans, and remarks on the geological character of over 400 caves now known to exist in the State. --Auth.

1-75. Brice, James C. ORIGIN OF STEPS ON LOESS-MANTLED SLOPES: U. S. Geol. Survey, Bull. 1071-C, p. 69-85, figs. 5-10, pls. 2-3, Nov. 1958.

Steps that consist of bare scarps and sod-covered treads have developed in many places on steep loess-mantled slopes in southern Nebraska, western Iowa, and northwestern Missouri. The steps are retreating upslope as the sod-capped scarps are undercut by sheetwash. Sediment production appears to be much greater from stepped slopes than from smooth slopes, and understanding of the origin of steps should be useful in planning measures for the control of slope erosion. Several hypotheses of origin are examined, and evidence is presented to show that the steps originate as low sod scarps which rim bare patches in the sod cover; these scarps increase in height by upslope retreat. --Auth.

1-76. Chikishev, A. G. OSNOVNYYE ZAKONOMERNOSTI RASPREDELENIYA POCHVENNOGO POKROVA NA SREDNEM URALE [BASIC REGULARITIES OF THE DISTRIBUTION OF SOIL OF THE CENTRAL URAL AREA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 163, 1958.

Resume of lecture given March 5, 1958. Soils covering the central Ural area have been thoroughly studied, and a soil map, (scale 1:1,000,000) has been issued. The soils of the central Ural show a great variety due to the diversity of rocks, the extreme dissection of the relief, climatic and vegetative peculiarities. The basic soils are of the podzolic type with varying degrees of leaching. In the northern half, typical podzolic soils predominate, while in the southern part, turf-podzolic soils prevail. On the ridge zone are widely distributed mountain-podzolic, mountain-meadow, and mountain-forest soils, which are generally gravelly. At the extreme S. of the Cis and Trans-Ural areas there are minor massifs of black soil, partly podzolic. By analyzing soil-forming factors, and the nature of distribution of soil varieties, the existing soil-geographical differences of various parts of the examined territory, as well as the genetic boundaries between them, can be established. The author subdivided the central Ural soil-geographical province into 3 regions. --LC

1-77. Lenk-Chevitch, P. BEACH AND STREAM PEBBLES: Jour. Geology, v. 67, no. 1, p. 101-106, 3 figs., 2 pls., Jan. 1959.

Typical beach pebbles have a convex symmetry line (or bisector line). The apexes of the extremities of the pebble are bent back to one of the sides of the symmetry line. The line joining the apexes (or apical line) and the structural lines of the pebble (stratification, etc.) are parallel or very slightly inclined to the general axis of the pebble. Typical stream pebbles have a relatively straight bisector line. The apical line and the structural lines lie across and askew of the general axis of the pebble. Pebbles for examination must be selected according to certain rules. --Auth.

1-78. Liliyenberg, D. A. ISTORIYA FORMIROVANIYA RECHNOY SETI YUGO-VOSTOCHNOGO KAVKAZA (DIBRARO-SHEMAKHINSKIY I KOBYSTANSKIY RAYONY) [THE HISTORY OF THE FORMATION OF THE RIVER SYSTEMS OF THE SOUTHEASTERN CAUCASUS (DIBRARO-SHEMAKHA AND KOBYSTANSKIY DISTRICTS)]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel. Geol., v. 33, no. 3, p. 160-61, 1958.

Resume of lecture given Feb. 23, 1958. The region of recent tectonic uplift in the southeastern Caucasus, especially in the Dibraro-Shemakha and Kobystanskiy districts, contain numerous traces of transformed ancient river systems of the Pliocene epoch and Quaternary period. There are a great number of hanging sections of continuous valleys with remains of boulder conglomerates and well-preserved systems of ancient terraces. The author cites numerous ancient valleys which are clearly discernable. Reconstruction of the drainage system shows that during the Neogene period, this system coincided with the general trend of the Caucasian mountains and their basic tectonic structure. Apparently, the longitudinal valleys already existed during the Maykop and Sarmatian stage. The basic changes of the drainage system resulted from a general anticlinal uplift of the southeastern Caucasus, whereby the longitudinal valleys were lifted to different heights. --LC

1-79. Chichagov, V. P. OSNOVNYYE CHERTY RELYEFA I OSOBENNOSTI GIDROGRAFICHESKOY SETI YUGO-VOSTOCHNOGO ZABAYKALYA [BASIC CHARACTERISTICS OF THE DEVELOPMENT OF THE RELIEF AND PECULIARITIES OF THE DRAINAGE SYSTEM OF THE SOUTHEASTERN TRANSBAIKAL REGION]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 161-62, 1958.

Resume of lecture given Feb. 25, 1958. According to morphologic and paleogeographic characteristics, the relief of the southeastern Transbaikalia region can be subdivided into 3 large geomorphological districts: 1) the western geomorphological district of the Daurskiy and Boshchovochnyy ridges; 2) the central district of eroded, sedimentary plains and the plateau region of the middle course of the Onon river; 3) the eastern geomorphological district of the low ridge region of the inter-river region of the Shilka and Argun' rivers. These geomorphological districts are separated by ancient depressions. During the Quaternary period, the river system underwent fundamental changes, evidenced by inundated valleys located in the inter-river regions of the Ingoda, Chikoy and Khilok rivers. --LC

1-80. Mukhina, L. I. TIPY MESTNOSTI VITIMSKOGO PLOSKOGOR'YA I OSNOVNYYE ZAKONOMERNOSTI IKH RASPROSTRANENIYA [REGIONAL TOPOGRAPHIC FEATURES OF THE VITIMSKOYE PLOSKOGOR'YE AND THE BASIC PATTERNS OF THEIR DISTRIBUTION]: Moskov, Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 162-63, 1958.

Resume of lecture given March 5, 1958. The Vitimskoye Ploskogor'ye (plateau, 54°N. $113^{\circ}30'$E.), a unique region of the Transbaikalia, is characterized by a relatively monotonous and unbroken relief, a continental climate and a predominance of deciduous forests. The author describes the varieties of plants constituting the flora of the taiga, and changes in vegetation as a result of topographical, climatic and soil conditions. --LC

3. STRUCTURAL GEOLOGY

See also: Igneous and Metamorphic Petrology 1-211; Mineral Deposits 1-252.

1-81. Handin, John, and Rex V. Hager, Jr. EXPERIMENTAL DEFORMATION OF SEDIMENTARY ROCKS UNDER CONFINING PRESSURE: TESTS AT HIGH TEMPERATURE: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2892-934, 31 figs., Dec. 1958. Also pub. as: Shell Devel. Co., Explor. and Research Div., Pub. no. 130.

Short-time triaxial compression tests of dry anhydrite, dolomite rock, limestone, sandstone, shale, siltstone, slate, and halite single crystals under pressure-temperature conditions simulating depths down to 30,000 ft. reveal the following.

1. Invariably an increase of pressure at constant temperature increases the yield stress, but an increase of temperature at constant pressure reduces it.
2. An increase of pressure at constant temperature always enhances the ultimate strength. However, heating at constant pressure may raise the ultimate strength by increasing the ductility of work-hardening rocks. More commonly heating lowers the ultimate strength by eliminating work-hardening, so that even though a rock is more ductile, it is weaker because its yield stress is reduced.
3. In any event for all materials tested except the halite, the ultimate strength at any simulated depth exceeds the crushing strength at atmospheric conditions. Below about 15,000 ft. the strength of halite is less than that at the surface.
4. The effect of heating up to 300°C. on the

strength and ductility of anhydrite, dolomite, sandstone, and slate is small. However, the strength of limestone, shale, and siltstone at room temperature exceeds that at 300°C. by about 50%, and of halite by nearly 7 times.

Work in progress will more realistically simulate the natural environment of deeply buried rocks by introducing an independently controlled fluid pore pressure. It will be possible to assess the effects of confining pressure, pore pressure, and temperature separately and to predict the short-time deformational behavior of most sedimentary rocks for a wide variety of conditions. --Auth.

1-82. Sanford, Allan R. ANALYTICAL AND EXPERIMENTAL STUDY OF SIMPLE GEOLOGIC STRUCTURES: Geol. Soc. America, Bull., v. 70, no. 1, p. 19-52, 20 figs., 2 pls., Jan. 1959.

An analytical method is derived which gives the elastic response of a homogeneous rock layer to two-dimensional distributions of vertical displacement applied along its lower boundary. Displacement field, stress distribution, and distortional strain-energy density diagrams are presented for 3 types of displacement applied at the lower boundary of 5-km thick layers possessing average sedimentary rock properties. These 3 types of displacement are: (1) sinusoidal vertical displacement and no horizontal displacement; (2) an approximate step in vertical displacement and no horizontal displacement; and (3) sinusoidal vertical and horizontal displacement (horizontal displacement 90° out of phase with the vertical). Displacement fields and stress distributions for each type of applied displacement are nearly independent of the elastic characteristics of the layers. The magnitudes of displacement necessary to initiate fracture at some point in the layer are small (3.7-8.2 m) for the 3 types of applied displacement. For applied displacement (1) and (3), the initial fracture is a vertical tensile crack at the crest of the fold. For applied displacement (2), the initial fracture is either a vertical crack at the upper surface or a shear fracture at the lower surface.

Displacement fields and fracture patterns for scale-model experiments of 2 problems similar to the analytical examples are presented. For a sinusoidal vertical displacement, the fracture pattern is a complex zone of normal faults which taper inward toward the axis of the fold and die out at depth. For a step in vertical displacement, the fracture pattern is (1) a series of reverse faults which start vertically at the base of the layer, curve, and intersect the upper surface at low angles, and (2) a series of normal faults dipping toward the convex side of the reverse faults. Of particular interest are the reverse faults which show that vertical movement at depth can generate low-angle faulting at the surface.

Displacement fields found in the elastic analyses are good first-order approximations of displacement fields in the scale-model experiments. Points of initial fracture observed in the model experiments agree closely with those computed in the elastic analyses. The line of fracture for the curved reverse faults in the model experiments can be predicted on the basis of the Mohr fracture criterion and the stress distribution from an elastic analysis. --Auth.

1-83. Weiss, L. E. GEOMETRY OF SUPERPOSED FOLDING: Geol. Soc. America, Bull., v. 70, no. 1, p. 91-106, 12 figs., Jan. 1959.

Two simple kinematic models of folding in tectonites have been adopted and diagrams prepared to show ideal geometrical transformations of a set of parallel surfaces (S) as a result of superposition of one generation of folds on another.

It is found for both models of folding that a second generation does not necessarily form folds with constant trend and plunge. These folds depend for their axial orientation on the attitude of S in which they form. It was found also that cylindroidal folds of a second generation are necessarily smaller and less pertinent in axial direction that those of an earlier generation.

Geometry of rotation of early formed B lineations by later folding is different for the 2 models of folding adopted. Where the second folding is by flexural slip of S, the earlier lineations follow small-circle paths in projection, as described by Sander. Where S is slip-folded by the second deformation, earlier lineations ideally follow great-circle paths in projection. Some departures from this ideal geometry to be expected in nature are listed. --Auth.

1-84. Whitten, E. H. Timothy. A STUDY OF TWO DIRECTIONS OF FOLDING: THE STRUCTURAL GEOLOGY OF THE MONADHLIATH AND MID-STRATHSPEY: Jour. Geology, v. 67, no. 1, p. 14-45, 13 figs., incl. geol. maps (1 fold), Jan. 1959, 112 refs.

A review of the different ways in which more than one direction of folding has been thought to occur in one area and a classification of the different varieties of cross folding described in the literature are given. An area of complex folding in Moine metasediments is described. Consideration of the style of folding and the orientation of axial planes supports the view that an initial phase of homoaxial folding developed about axes plunging southeastward. This folding was accompanied by slide tectonics repeating the succession in large tectonic inclusions. The deformation was monoclinic and apparently in response to a regional sinistral movement (looking northward along the fold axes). A second phase of folding turned the folds of half the area through about 48°, producing a dominant southwesterly trend and a sharp junction line with crossing (mainly E.-W.) structures at the boundary between the originally disposed and the rotated block. Dislocation of the line of junction proves the magnitude of the transcurrent Strathspey and Calder Valley faults. --Auth.

1-85. Menner, V. V., and M. Ye. Raaben. K VOPROSU O PRIRODE MELKIKH SKLADOK V MEZOZOYE VOSTOCHNOGO PRITIMAN'YA [ON THE NATURE OF MINOR FOLDS IN MESOZOIC ROCKS OF THE EASTERN TIMAN REGION]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 84-87, fig., map, 7 refs.

The authors deal with minor folds which are widespread in sedimentary rocks of Mesozoic and Paleozoic age on the Russian platform. The subject of their study are groups of these folds in the region of eastern Timan (65°N. 51°E.), situated on the south-western edge of the Pechora synclise. Comparing these folds with the contemporary folds found in landslide masses of the Volga region, the authors conclude that the ancient folds of the Jurassic period were of landslide origin. Their connection with the geomorphologic elements confirms these conclusions. --LC

1-86. Kent, P. E. RECENT STUDIES OF SOUTH PERSIAN SALT PLUGS: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2951-72, 8 figs., Dec. 1958

In 1948-1951 traverses of unexplored country near the Persian Gulf between Bushire and Lingeh during exploration work by the British Petroleum Company Limited permitted investigation of 9 emergent salt plugs additional to those previously described. Two possible non-emergent plugs were also located. The geology of different types of the emergent plugs is described with emphasis on features of regional and genetic significance. A recent suggestion that igneous activity has played an important part in initiation of Persian salt-plug movement is not supported by the detailed studies. The stratigraphy of the associated rocks shows a clear distinction between those which reached surface by middle Miocene or earlier and those associated with the Pliocene Zagros orogeny.

Many of the plugs located down-pitch on folds are of early origin, while those located on structural culminations are more commonly intra- or post-orogenic. This suggests that an early plug may have provided a point of weakness to initiate a later fold-line, but that exhaustion of the mobile Cambrian salt locally limited movement by Abscherung so that maximum fold development took place farther along the strike. The core of squeezed-up salt in the culmination might in turn become diapiric, but would be post-orogenic. --Auth.

1-87. Naha, Kshitindramohan. TIME OF FORMATION AND KINEMATIC SIGNIFICANCE OF DEFORMATION LAMELLAE IN QUARTZ: Jour. Geology, v. 67, no. 1, p. 122-26, 2 figs., Jan. 1959.

Poles of deformation lamellae in quartz in a folded quartz-mica-schist show 2 maxima in an incomplete girdle normal to the fold axis and are symmetrically situated with reference to late tension cracks in garnet. The deformation lamellae have thus formed late in the movement history of the rock, coinciding with the conjugate shear planes developed because of non-rotational strain after the megascopic fold with monoclinic symmetry was formed. --Auth.

1-88. Mayo, Evans B. LINEAMENT TECTONICS AND SOME ORE DISTRICTS OF THE SOUTHWEST: Mining Engineering, v. 10, no. 11, p. 1169-75, 4 maps, Nov. 1958; also pub. in AIME Trans., v. 211, 1958.

The objectives are to examine the structural framework of southwestern United States for evidence of the 4 principal directions, or trends, of lineament tectonics; to attempt a classification of their intersections; and to compare the positions of the most favorable-appearing ones with the positions of the ore districts. Insufficient data and the unavoidable personal equation make these objectives very difficult to attain. --Auth.

1-89. Stewart, Samuel W. GRAVITY SURVEY OF OGDEN VALLEY IN THE WASATCH MOUNTAINS, NORTH CENTRAL UTAH: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1151-57, 4 figs. incl. geol. map, Dec. 1958.

From geologic investigations it is inferred that [NW.-trending] Ogden Valley is structurally controlled by normal faults along both the NE. and SW. margins. Gravity measurements in the valley indicate a fault with about 2000 ft. of vertical displacement along the W. margin of the valley. A fault with at least 1000 ft. of vertical displacement is postulated along the E. margin of the valley, and a smaller, buried fault is postulated within the valley. The maximum thickness of Cenozoic sediments and sedimentary rocks in the valley is estimated to be about 5000 ft. --Auth.

4. STRATIGRAPHY AND HISTORICAL GEOLOGY

See also: Paleontology 1-129, 1-132, 1-140; Geochemistry 1-185, 1-186; Mineral Deposits 1-268.

1-90. Saskatchewan Geological Society. REPORT OF THE LOWER PALAEOZOIC NAMES AND CORRELATIONS COMMITTEE: Regina, Sask., 20 p., 9 illus., 4 stratig. cross-secs. (separately-bound), Dec. 1958.

Silurian, Ordovician, and Cambrian strata extend through about 250,000 sq. mi. of the sparsely-explored northern part of the Williston Basin and adjacent areas (Saskatchewan and Manitoba (Canada) and North Dakota and Montana (U.S.A.)). Four cross-sections, incorporating lithological, radioactivity and electrical logs of 31 boreholes, illustrate the subdivision, terminology, and distribution of the strata. Eight stratigraphic subdivisions of the Silurian and Ordovician rocks are concisely and systematically described in terms of type locality, authors, lithology, distribution, and stratigraphic relations. Their subsurface type-sections are defined and illustrated.

The report is intended to provide a common nomenclature and a basis for precise geological mapping in the course of petroleum exploration. --J.G.C.M. Fuller.

1-91. Jicha, Henry L., Jr., and Christina Lochman-Balk. LEXICON OF NEW MEXICO GEOLOGIC NAMES: PRECAMBRIAN THROUGH PALEOZOIC: New Mexico Bur. Mines & Mineral Resources, Bull. 61, 137 p., 1958.

Acceleration of geologic work in New Mexico has emphasized the need for an up-to-date lexicon of published geologic names used in the State.

The preparation of such a lexicon was initiated in 1956 with the publication of names from the Precambrian through the Devonian eras (New Mexico Bur. Mines & Mineral Resources, Circ. 40, by H. L. Jicha, Jr.). The listing is now extended to embrace the Mississippian, Pennsylvanian, and Permian periods. The material presented in Circ. 40 has been incorporated in the new compilation. Thus, the present bulletin provides coverage of all geologic names used in publications on New Mexico geology from the Precambrian through the Permian.

In general, the pattern adopted by Wilmarth

(1938) has been followed. Names printed in boldface are those currently used by the U.S. Geological Survey. Names in boldface preceded by an asterisk (*) are accepted by the U. S. Geological Survey but have not been extended into New Mexico by Survey geologists. Names preceded by a dagger ( ) have either been abandoned by their authors or rejected by the U. S. Geological Survey. The New Mexico Bureau of Mines and Mineral Resources recommends the suppression of those names which are preceded by a double dagger ( ).

County names and other locality designations mentioned in the line below the captions seldom indicate the exact geographic distribution of the unit described; they serve, however, as clues to the part of the State in which the unit occurs. --Auth.

1-92. Hill, Mason L., Stanley A. Carlson, and Thomas W. Dibblee, Jr. STRATIGRAPHY OF CUYAMA VALLEY-CALIENTE RANGE AREA, CALIFORNIA: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2973-3000, 11 figs., Dec. 1958.

The 1948 discovery of oil in Cuyama Valley has focused attention on the geology of this region. The development of stratigraphic data has necessitated the use of a number of new and redefined rock-stratigraphic terms. Therefore, the following names are submitted with the belief that their consistent usage will facilitate progressive geologic discussions and interpretations: Pattiway formation, Eocene (?); Simmler formation, continental Oligocene (?); Soda Lake sandstone, Soda Lake shale, and Painted Rock sandstone members of the lower Miocene Vaqueros formation; Saltos shale and the redefined Whiterock Bluff shale members of the lower and middle Miocene Monterey formation; Branch Canyon formation, middle Miocene; Caliente formation, continental lower and middle Miocene; Quatal formation, continental upper Miocene; and the redefined Morales formation, continental Pliocene (?).

Other unnamed Eocene and Cretaceous strata occur in the area, but the assignment of rock unit names would be premature here. Igneous and metamorphic rocks consist of pre-Upper Cretaceous granitic and gneissic types and middle Miocene basaltic flows and sills. Most of the outcropping rock units have also been encountered in drill holes, and several of them are now proved as oil reservoirs. --Auth.

1-93. Gastil, Gordon. OLDER PRECAMBRIAN ROCKS OF THE DIAMOND BUTTE QUADRANGLE, GILA COUNTY, ARIZONA: Geol. Soc. America, Bull., v. 69, no. 12, p. 1495-1514, 6 figs., 2 col. geol. maps, Dec. 1958.

Rocks intruded by Precambrian granite have been previously described in several districts of central Arizona, but it has not been possible to demonstrate their stratigraphic order. In the Diamond Butte quandrangle 5 older Precambrian formations can be placed in depositional sequence. The oldest is the Alder Formation, consisting of wacke,. slate, quartzite, and conglomerate. It is conformably overlain by the Flying W formation consisting of interbedded basic and acidic volcanic rocks and conglomerate. This is overlain with slight unconformity by the conglomerate, quartzite, and slate of the Houden formation. Above the Houden is the Board Cabin formation composed of porphyritic, pillow, and pyroclastic volcanic rocks, and volcanic sediments. The rhyolites and conglomerates of the Haigler formation complete the sequence. The Haigler is believed to be overlain by still younger rhyolites, and the Alder may be underlain by an older sequence of slate and basic volcanic rocks.

This volcanic-sedimentary rock sequence portrays a recurrently unstable marine environment in which a large portion, if not all, of the sediment was derived from contemporary volcanic rocks. Through time the parent magma became enriched in potassium and silicon, and finally engulfed its own extrusive and sedimentary deposit to crystallize at relatively shallow depths as quartz porphyry, granophyre, and granite.

Evidence of pre-existing metamorphic or plutonic rocks has not been found, and this depositional-orogenic cycle may represent the initial continental formation in this area. --Auth.

1-94. Pavlovskiy, Ye.V. KRATKIY OCHERK DOKEMBRIYA I NIZHENEGO PALEOZOYA SHOTLANDSKIKH NAGORIY [SHORT OUTLINE OF THE PRECAMBRIAN AND LOWER PALEOZOIC FORMATIONS OF THE SCOTTISH HIGHLANDS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 23-47, 5 figs., table, 40 refs.

This is the first part of an article titled "Peculiarities in the Development of Caledonides in Scotland"; The second part will be published in the next issue of this periodical. A detailed description of the older formations of the Scottish Highlands is given.

The Soviet delegation at the 2nd session of the Association for the Study of the Earth's Crust, held in Sept. 1957, included the following scientists: Member-Correspondent of the Acad. Sci. USSR, L.V. Pustovalov (Head of the delegation). Academician of the Kazakh Acad. Sci. SSR, P.A. Borukayev, and the author of this article. --LC

1-95. Roberts, Ralph J., Preston E. Hotz, James Gilluly, and H. G. Ferguson. PALEOZOIC ROCKS OF NORTH-CENTRAL NEVADA: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2813-57, 11 figs., Dec. 1958.

Recent geologic mapping and stratigraphic study in north-central Nevada has increased our knowledge of the Paleozoic stratigraphy and structural history of this complex area. The present paper summarizes the stratigraphy and outlines a suggested synthesis of the Paleozoic geologic history.

Eastern Nevada differs greatly in stratigraphy and structural history from the western part. In eastern Nevada, roughly east of longitudes 116°-117°, the Paleozoic rocks from Middle Cambrian to Upper Mississippian are mostly limestone and dolomite with minor amounts of shale and quartzite. In central and western Nevada the correlative strata are predominantly clastic sedimentary rocks and chert, with intercalated volcanic rocks and pyroclastics. The eastern assemblage is on the order of 15,000 ft. thick in most places; the western assemblage is much thicker, probably more than 50,000 ft. The depositional environments of the eastern and western assemblages were clearly different. The eastern assemblage is miogeosynclinal, the western eugeosynclinal. The two have been brought into contact by telescoping along a thrust fault of great magnitude - the Roberts Mountains thrust - which carried the western assemblage relatively eastward or southeastward over the eastern assemblage.

In several places an assemblage that does not belong clearly to either the eastern or western assemblages, but includes elements of both, is recognized as transitional. Rocks of the transitional assemblage occur both in parautochthonous windows beneath the Roberts Mountains thrust plate of western assemblage rocks, and as slivers in the upper plate of the thrust.

The broad geosyncline in which the 3 assemblages were laid down persisted, with local disturbances beginning in Late Cambrian, until the end of Devonian time. A belt along the 116^{o}-118^{o} meridians - the Antler orogenic belt - was the locus of intense folding and faulting that culminated in the Roberts Mountains thrust fault in Late Devonian or Early Mississippian time. From an emerged area along this belt coarse clastic rocks were deposited both eastward and westward; these grade laterally into finer sediments and limestone of normal marine facies. In the orogenic belt the sediments that were deposited on the deformed strata of the eastern, transitional, and western assemblages, are designated the overlap assemblage. Orogenic movements continued along the belt in Pennsylvanian and Permian time, and throughout the Mesozoic, probably into Cretaceous time, causing further deformation of the previously folded and thrust-faulted rocks and of the sediments of the overlap assemblages as well.

A correlation chart and representative stratigraphic sections of the several stratigraphic assemblages are included. --Auth.

1-96. Hamblin, William Kenneth. THE CAMBRIAN SANDSTONES OF NORTHERN MICHIGAN: Michigan Geol. Survey Div., Pub. 51, 146 p., 89 figs., 4 geol. maps, 1958, 69 refs.

Cambrian rocks are exposed along most of the S. shore of Lake Superior from the tip of Keweenaw Peninsula to Sault Ste. Marie. The oldest formation of Cambrian age is the Jacobsville sandstone which contains 4 distinct facies. Conglomerate lenses occur near the basal contact of the Jacobsville and interfinger with the lenticular sandstone facies which constitute the major part of the formation. Sorting, composition, variations in thickness, and sedimentary structures indicates that the conglomerate and lenticular sandstone facies represent a terrestrial deposit which accumulated in an intermountain basin. Massive sandstone and red siltstone occurring near the top of the section represent an upward change from a predominantly fluvial to lacustrine environment.

The Jacobsville formation was deposited upon a highly irregular surface cut into Precambrian rocks which range in age from Laurentian to Middle Keweenawan. It pinches out completely to the south and thickens greatly to the north and is thus wedge-shaped. Primary sedimentary trends and other evidence indicate that the source area was an elongated highland extending in an E.-W. direction through the Northern Peninsula. This positive area, termed the Northern Michigan Highland, had a prolonged effect upon the sedimentation of the Jacobsville and younger sediments.

A low-dip angular unconformity between the Jacobsville and Munising formations at Grand Island indicates the age of the Jacobsville to be between Middle Keweenawan and Upper Cambrian. The present evidence shows that the Jacobsville is not genetically related to the Keweenawan and is, therefore, most likely Middle and Early Cambrian in age.

The Munising formation consists of a marine sandstone which the writer has divided into 3 members. The oldest member is an orthoquartzitic conglomerate and is overlain conformably by the Chapel Rock member, which is characterized by large-scale cross-bedding, good sorting, and high zircon. Cross-bedding and ripple marks indicate that the Northern Michigan Highland persisted and acted as the major source for the Chapel Rock member. The Chapel Rock member represents a simple transgressive-regressive cycle and is overlain unconformably by the Miner's Castle member.

The Miner's Castle member consists of a poorly sorted sandstone characterized by small-scale cross-bedding and a heavy mineral suite remarkably high in garnet. The Miner's Castle sea transgressed rapidly from the SW. across the Wisconsin Arch and Northern Michigan Highland onto the Canadian Shield.

The distinctive heavy mineral suites of the Chapel Rock and Miner's Castle members permit a rather accurate correlation between the outcrops along the coast of Lake Superior and the outliers in Dickinson County. Fossils found in several places in Dickinson County indicate a correlation between the Miner's Castle member and the Franconia of Wisconsin. The Chapel Rock member is, therefore, considered to be equivalent to the Dresbach formation because of the similarity in heavy mineral suites and because of their unconformable position below the Franconia.

The name Au Train formation is proposed for the sandy dolomite which separates the Munising formation from the Bony Falls limestone of the Black River group. Fossils indicate it is Middle Ordovician. --Auth.

1-97. Gutstadt, Allan M. CAMBRIAN AND ORDOVICIAN STRATIGRAPHY AND OIL AND GAS POSSIBILITIES IN INDIANA: Indiana Geol. Survey, Bull. 14, 103 p., 17 figs., pl., 1958, 79 refs.

Cambrian and Ordovician rocks throughout most of Indiana are subdivided in ascending order as follows: lower part of the St. Croixan series, consisting of the Mt. Simon sandstone and the Eau Claire formation; upper part of the St. Croixan series and the Canadian series, consisting of the Knox dolomite; the Chazyan series, consisting of the St. Peter sandstone and the Joachim dolomite; the Mohawkian series, consisting of the Black River limestone and the Trenton limestone; and the Cincinnatian series, consisting of the Eden group (undifferentiated) and the Maysville-Richmond group (undifferentiated).

The Mt. Simon sandstone, the Eau Claire formation, and the lower part of the Knox dolomite may be facies that represent contemporaneous environments, respectively, of beach or littoral deposition, nearshore deposition, and offshore deposition. The St. Peter sandstone was deposited unconformably on the eroded surface of the Knox and was succeeded by carbonate deposition until late Ordovician time. The Cincinnatian series represents shallow-water deposition where the physical and biological environments alternated rapidly between clear water and optimum conditions for life, and muddy water and unfavorable conditions for life.

The Mt. Simon sandstone and the Eau Claire formation are virtually untested for oil and gas, although the Mt. Simon has ideal reservoir characteristics of the "blanket-sand" type, and the Eau Claire exhibits rapid local changes in porosity which might serve to localize accumulations of oil or gas. The Knox dolomite contains highly permeable zones, and many shows of gas have been reported although commercial production is lacking. The St. Peter sandstone has been considered a good prospect for oil or gas, but remarkably few shows of either have been reported. Any oil or gas found in the Black River most likely will be in local dolomitized lenses. Additional Trenton production might be found in northern Indiana, where the formation consists of dolomite, and possibly in southern Indiana, where the formation contains interbedded shale. Only a few shows have been reported from Cincinnatian rocks, and possibilities are not attractive because of the lack of good reservoir rocks. --Auth.

1-98. Gussow, William Carruthers. ATHABASCA FORMATION OF WESTERN CANADA: Geol. Soc. America, Bull., v. 70, no. 1, p. 1-18, 7 figs. incl. geol. maps, secs., Jan. 1959.

Geological reports over the past 50 years have so confused the age designation of the Athabasca formation that logic has been abandoned, even in the face of new evidence that the current Precambrian designation is untenable.

The absolute age of the Athabasca formation cannot be fixed without fossil evidence. Herein, it is tentatively assigned to the Middle Devonian? or Late Cambrian? on the basis of structural relationships and lithologic characteristics, with full awareness of the risk involved in such a practice. The name Martin Lake series is here introduced for the ancient folded and faulted sedimentary-volcanic rocks of the Martin Lake area, which have been erroneously correlated with the Athabasca formation. Recent dating indicates that they are late Early Precambrian and are much older than the "Late Proterozoic" to which they have been assigned.

This is an example of the need for a revision of the Precambrian time classification and the abandonment of terms such as Proterozoic, Algonkian, and Archean, which are carry-overs from the old concept of a twofold subdivision of the Precambrian - now known to be at least 5 to 6 times as long as the fossil record. --Auth.

1-99. Pinsak, Arthur P. SUBSURFACE STRATIGRAPHY OF THE SALEM LIMESTONE AND ASSOCIATED FORMATIONS IN INDIANA: Indiana Geol. Survey, Bull. 11, 62 p., 8 figs., 5 pls., 1957, 39 refs.

The Meramec series (middle Mississippian) in Indiana is composed of a virtually continuous sequence of shallow-water limestones that underlie the southwestern one-third of the State and thicken in a southwesterly direction to a maximum of nearly 1,000 ft. Formational boundaries can be defined throughout most of the areal extent, but are vague and gradational in the extreme southwestern part of Indiana.

The Salem limestone (lower Meramec) is widely known because of its peculiar diminutive fauna and its extensive use as a building stone. The distinctive foraminiferal limestone is recognized easily on outcrop in the building stone district which extends from Washington County into Owen County. Except for local occurrences of the foraminiferal limestone, the formation is distinguished with some difficulty on outcrop around the remainder of the Illinois Basin.

Deposition of the Salem limestone was subject to 3 distinct environments. In the northern area of occurrence the formation is a near-shore (epineritic) deposit, in the central area it is a shelf (infraneritic) deposit, and in the extreme southwestern part of the State the sediments were deposited in a basin environment. In the area of shelf deposition, which is expressed at the surface in the building stone district, the Salem can be differentiated from overlying and underlying limestones. In the areas of near-shore and basin deposition, the Harrodsburg and Salem limestones are lithologically similar, and formational boundaries are vague.

The Salem limestone in the shelf area was deposited in the same manner as a quartz sandstone and exhibits the characteristics of a well-sorted subareal [sic] sandstone. Local structural anomalies expressed at the top of the formation are due to localized bar development within the clastic part of the formation or to differential compaction of underlying sediments.

Oil which is produced from the Salem limestones in Indiana is restricted geographically to the shelf (infraneritic) area. Environmental conditions N. and S. of the shelf area apparently were not favorable for oil accumulation. The oil is present within a few feet of the top of the formation in the foraminiferal limestone. Mode of occurrence of the oil indicates that the rocks were tilted to the SW. after accumulation of the oil. --Auth.

1-100. Perry, T. G., and Ned M. Smith. THE MERAMEC-CHESTER AND INTRA-CHESTER BOUNDARIES AND ASSOCIATED STRATA IN INDIANA: Indiana Geol. Survey, Bull. 12, 110 p., fig., 6 pls., incl. geol. map (in pocket), scale 1 in. to 2 mi. (approx.), 1958, 63 refs.

The Ste. Genevieve limestone (late Meramec) and Chester formations (late Mississippian) crop out in a northward-narrowing wedge from the Ohio River to W.-central Putnam County, in central Indiana. Their exposure belts include parts of Harrison, Crawford, Washington, Orange, Lawrence, Martin, Monroe, Greene, Owen, and Putnam counties. Chester strata, but not the Ste. Genevieve limestone, crop out in Perry and Dubois counties.

Mapping the upper boundary of the Ste. Genevieve limestone establishes the areal occurrence of the Meramec-Chester contact and also aids in the determination of the geographic distribution of the lower Chester group. Mapping the upper boundary of the Beech Creek limestone completes the areal delineation of the lower Chester group. Mapping the top of the Glen Dean limestone determines the areal extent of the middle Chester group and also the exposure belt of the upper Chester group, because the Mississippian-Pennsylvanian boundary as shown on the geologic map of Indiana (Indiana Dept. Conserv., Pub. 112) is essentially correct. Measured sections that display the mapped boundaries are included in this report to indicate the characteristics of the strata that are associated with these contacts.

Pre-Pennsylvanian erosion removed progressively older Mississippian formations at increasing distances N. of the Ohio River. Thus, the Ste. Genevieve limestone and lower Chester formations crop out from the Ohio River to Putnam County, where they have been largely removed by pre-Pennsylvanian erosion; the middle Chester group is represented locally in southern Owen County by only the Cypress and Golconda formations; and rocks of the upper Chester group occur very locally or are absent N. of the East Fork of White River. Because of the relief on the pre-Pennsylvanian unconformity, Meramec and Chester formations near the Mississippian-Pennsylvanian boundary are exposed unpredictably and locally.

Structural contours were drawn on the upper surface of the Ste. Genevieve and Beech Creek limestones throughout their outcrop belts in Indiana; a 50-ft. contour interval was selected to conform with the number and accuracy of field observations. The contoured surfaces reveal mild, persistent structural anomalies and well-defined local basins and domes. The regional strike of the Ste. Genevieve and Beech Creek limestones is about N. 25° W., and their regional southwesterly dip averages 25 to 40 ft. per mi.

Economic products of the Ste. Genevieve, Aux Vases, Paoli, Beech Creek, Golconda, and Glen Dean formations are mainly crushed stone and agricultural lime. Many springs emerge from the base of Chester limestones, particularly the Beech Creek, and commonly afford a convenient water supply for part of the rural population in the outcrop belt of the Chester series. --Auth.

1-101. Laudon, Richard B. **CHESTERIAN AND MORROWAN ROCKS IN THE McALESTER BASIN OF OKLAHOMA:** Oklahoma Geol. Survey, Circ. 46, 30 p., 14 figs. incl. 8 maps, 5 cross-secs., 1958, 41 refs.

Outcrops were examined and data from 72 bore holes were evaluated. The Fayetteville shale thickens southwestward and grades into the Caney shale. The Pitkin limestone grades into the upper part of the Caney shale and underlies the Goddard shale. The Goddard shale occurs in subsurface in the western part of the basin, but does not reach outcrop in the Ozark area. In the basin, sedimentation was continuous from the Mississippian into the Pennsylvanian. --Auth.

1-102. Gehrig, John Leonard, **MIDDLE PENNSYLVANIAN BRACHIOPODS FROM THE MUD SPRINGS MOUNTAINS AND DERRY HILLS, NEW MEXICO:** New Mexico Bur. Mines & Mineral Resources, Mem. 3, 24 p., fig., 6 pls., 1958.

A brachiopod fauna from carefully measured sections of the lower part (Derry and Des Moines series) of the Pennsylvanian in Sierra County, New Mexico, was studied to determine if the megafossils could be useful in designating and correlating the various units of the Pennsylvanian in this area.

It was found that strata belonging to the Derry and the Des Moines series could be distinguished on the basis of the contained brachiopod species. Several characteristic species from the Derry, which is believed to be younger than the Morrow of the midcontinent region, are similar to upper Mississippian forms. Brachiopods of the Bolander group in the upper part of the Desmoinesian show close affinities with those of the Marmaton group of Kansas.

It thus appears that both megafossils and microfossils can be used successfully to distinguish groups and series in the Pennsylvanian of New Mexico. --Auth.

1-103. Shelton, John W. **STRAWN-CANYON (PENNSYLVANIAN) BOUNDARY IN NORTH-CENTRAL TEXAS:** Geol. Soc. America, Bull., v. 69, no. 12, p. 1515-24, map, pl., Dec. 1958.

The Strawn-Canyon (Pennsylvanian) boundary in north-central Texas is evaluated from surface studies in the Colorado River and Brazos River valleys. Zonation based on fusulinids is the best criterion for defining the boundary. Strawn series is characterized by the genus Fusulina, Canyon series by Triticites. The brachiopod Mesolobus and bryozoan Prismopora, found in pre-Canyon beds, supplement the evidence. Because upper Strawn and lower Canyon units are generally not persistent in the outcrop area, the boundary is placed at 3 different stratigraphic positions so that locally prominent surfaces, which agree with paleontologic evidence, may be used as the contact. The Strawn-Canyon boundary in the Colorado River valley is considered to be the top of the Capps limestone, which is continuous to the north through Comanche County and most of Eastland County. In the southern part of the Brazos River valley the boundary is placed at the top of the "boulder" bed (of other investigators). This bed, which is present in northeastern Eastland County and southwestern Palo Pinto County, lies about 20 ft. above the Capps limestone. It is correlated with, and designated as, the Village Bend limestone of central Palo Pinto County. In eastern Palo Pinto County, the boundary is placed at the base of the Lake Pinto sandstone, which overlies the Village Bend limestone. --Auth.

1-104. Sloane, B. J., Jr. **THE SUBSURFACE JURASSIC BODCAW SAND IN LOUISIANA:** Louisiana Geol. Survey, Geol. Bull. no. 33, 33 p., 2 text figs., 8 illus. in separate map envelope incl. 7 elec. log cross-secs., subsurface structure & isopach map, scale 1 in. to 5 mi., well control tables (separately-bound), Mar. 1958.

The Dorcheat marine member of the Cotton Valley group (Jurassic) of the subsurface of N. Louisiana consists of interbedded blanket sands, black shales, and limestones. The blanket sands have yielded large quantities of oil and gas from many N. Louisiana structural and stratigraphic traps.

These Dorcheat blanket sands, one of which is the Bodcaw, coalesce into a massive sand section downdip. This massive sand development extends across western Louisiana in an E.-W. band and probably represents the position of an offshore bar. The blanket sands extend northward from the bar into the lagoonal black shales as individual tongues, thin to a knife edge and pinch out. Where the sands reach the shore line they interfinger with nearshore multicolored shales. N.-S. cross-sections demonstrate this condition.

The structural and isopachous map and structure section demonstrate the effects of regional structure upon the distribution of the Bodcaw sand. Apparently it is not greatly affected by local structure. The map also illustrates the considerable structural relief in the area surrounding the N- Louisiana syncline. This relief decreases nearer the positive Sabine and Monroe uplifts. Several of these domal structures have accumulations of oil and gas in the Bodcaw sand, and 2 structural noses along the updip limit of porosity have formed stratigraphic accumulations.

The organic-rich black shales suggest euxinic conditions developed in the partially restricted lagoons and are probably source beds of oil and gas. --Auth.

1-105. Lomize, M. G. **NOVYYE DANNYYE PO YURSKOMU VULKANIZMU SEVERO-ZAPADNOGO KAVKAZA [NEW DATA ON JURASSIC VOLCANISM OF THE NORTH-WEST CAUCASUS]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 147-48, 1958.**

Resume of lecture given March 20, 1958. Research work conducted during recent years by an expedition of the Moscow State University, headed by V. Ye. Khain, yielded new data on Jurassic volcanism of this region. It was established that the effusive and pyroclastic rocks, found between the Achishkho mountains (basin of the Mzymta river 43°27'N. 39°56'E.) and the Indyuk mountains are associated with the same volcanogenic-sedimentary series. This group can be subdivided into 2 formations: the lower - the Chataltapinskaya (approx. 900 m. thick); and the upper - the Indyuk mountains (approx. 2,000 m. thick). It can be stated, that longitudinal tectonic zoning features predominate as to the time element and volcanic characteristics of the NW. Caucasus. --LC

1-106. Merklin, R. L. **VPECHATLENIYA O VENGERSKOM MIOTSENE [IMPRESSIONS OF THE HUNGARIAN MIOCENE]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 155-56, 1958.**

Resume of lecture given Feb. 7, 1958. The author compares fossiliferous deposits found in Hungarian Miocene strata with those located in Tertiary deposits of the Crimean-Caucasus region. Deposits of the Sarmatian stage in Hungary contain several species of mollusks which are characteristic of the Lower Sarmatian stage of the Crimean-Caucasus region. --LC

1-107. Daniels, R. B., and R. L. Handy. **SUGGESTED NEW TYPE SECTION FOR THE LOVELAND LOESS IN WESTERN IOWA: Jour. Geology, v. 67, no. 1, p. 116-21, fig., pl., Jan. 1959; also pub. as Iowa, Agr. & Home Economics Expt. Sta., Jour. Paper No. J-3437.**

The type locality of the Loveland formation was destroyed in 1957 when the site was used as a borrow pit for road construction. A new cut adjacent to the type section is described and characterized by textural, organic-carbon, and mineralogical analyses. The exposure is recommended as a new type section. The sequence and characteristics of the Pleistocene deposits exposed in the new section are similar to those of the former type locality except for the lack of reddish color in the Loveland loess and the presence of 13.5 ft. of Farmdale loess, one of the largest thicknesses yet reported in Iowa. Distinguishing features of the Sangamon and Farmdale paleosols are color, texture, and content of organic carbon and the clay mineral vermiculite. --Auth.

1-108. Flint, Richard Foster, and W. A. Gale. **STRATIGRAPHY AND RADIOCARBON DATES AT SEARLES LAKE, CALIFORNIA: Am. Jour. Sci., v. 256, no. 10, p. 689-714, illus., maps, Dec. 1958, approx. 30 refs.**

Upper units of the strata beneath Searles dry lake, in a desert basin in southeastern California, record 2 deep lakes each followed by precipitation of evaporites and at least near-desiccation. Each lake is thought to imply a pluvial climate; the times of near-desiccation represent the warmer, drier, nonpluvial climate of today. C^{14} dates of samples from these strata show that the later of the 2 pluvial climates lasted from before 23,000 to ~ 10,000 yr. B.P.; it was therefore contemporary with the classical Wisconsin glaciation of central United States. The earlier pluvial had been well established by ~ 46,000 B.P. and had begun to wane before ~ 32,000 B.P. The later history of the lake in the Searles basin is in agreement with the published data on the later distory of Lakes Bonneville and Lahontan. Still earlier lake fluctuation can be discerned in underlying strata, but these are not controlled by dates. --Auth.

1-109. Fedorov, P. V. **STRATIGRAFICHESKOYE ZNACHENIYE KASPIYSKIKH CHETVERTICHNYKH MOLLYUSKOV V SVETE NOVYKH DANNYKH [THE STRATIGRAPHIC IMPORTANCE OF CASPIAN QUATERNARY MOLLUSKS IN THE LIGHT OF NEW DATA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 158-59, 1958.**

Resume of lecture given March 14, 1958. To the present time, stratigraphic classification of Quaternary deposits of the Caspian region was based on mollusks, mainly Didacna Eichw. However, it has been found that many of these guide faunal fossils occurred at various stratigraphic levels. Therefore, the age of deposits can not be judged exclusively by the presence of "guide" species, without taking into consideration living conditions, stratigraphy, and geomorphology. In spite of an abundance, and frequent predominance of local forms as well as ecologic varieties, it is possible by careful collecting of faunal fossils and by simultaneously considering the living conditions and quantitative relations, to single out reliable guide groups and species typical of distinct horizons found within the Caspian (and even Black Sea) region, which are connected with the main transgressions. The appearance of the group of D. tridonoides at the beginning of the Quaternary period leads to the conclusion that this species, and possibly several others (D. crassa Eichw.), first originated in the Caspian region. --LC

1-110. Larsen, Esper S., Jr., David Gottfried, Howard W. Jaffe, and Claude L. Waring. **LEAD-ALPHA AGES OF THE MESOZOIC BATHOLITHS OF WESTERN NORTH AMERICA: U. S. Geol. Survey, Bull. 1070-B, p. 35-62, figs. 5-6, Nov. 1958.**

The ages of some of the rocks from the 4 great groups of batholiths of western North America - Baja and Southern California, Sierra Nevada, Idaho, and Coast Range - have been determined by the ratio of Pb content to alpha activity of the accessory minerals, zircon, monazite, thorite, and xenotime. A suite of 10 intrusive rocks from Baja California, Guerrero, and Oaxaca, in Mexico, has a mean age of 101 ± 5 million years; the batholith of Baja California has been determined as being of early Late

Cretaceous age on the basis of stratigraphic and paleontologic evidence. Twenty-five age determinations on rocks from the batholith of southern California, ranging from tonalite to granite, give a mean age of 110 ± 13 million years; geologic evidence indicates that this batholith is early Late Cretaceous in age. Age determinations on 15 rocks from the Sierra Nevada batholith give a mean age of 102 ± 11 million years; on geologic evidence the Sierra Nevada batholith is considered to be Late Jurassic. Age determinations on 16 rocks from the Idaho batholith average 108 ± 12 million years; this batholith has been geologically dated as Cretaceous in age. Age determinations on 16 rocks of the Coast Range batholith, including the batholiths of Washington, British Columbia, and Alaska, average 105 ± 13 million years; these batholiths are believed to be equivalent in age to the Sierra Nevada batholith.

The ages of the 4 groups of rocks are the same - about 106 ± 12 million years; they are all believed to be early Late Cretaceous. The time required for emplacement of the entire batholithic system is believed to be only a few million years. The batholiths make a discontinuous echelon group of intrusive bodies about 4,000 mi. long and possibly much longer. --Auth.

1-111. Stoenner, R. W., and J. Zähringer. POTASSIUM-ARGON AGE OF IRON METEORITES: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 40-50, Nov. 1958, 26 refs.

The K^{41} and A^{40} have been determined in 7 specimens of 5 falls of iron meteorites. The measured A^{40} content was found to be principally radiogenic in origin, and associated with the potassium. Under the usual assumptions accepted for this method, ages have been calculated and found to be close to 10 X 10^9 years, which is about twice the reported age of stone meteorites, and also higher than the supposed age of the universe. --Auth.

5. PALEONTOLOGY

See also: Stratigraphy 1-102, 1-106, 1-109.

1-112. Butler, E. Ann, and Alan Cheetham. A NEW CRETACEOUS CRIBRIMORPH BRYOZOAN FROM LOUISIANA: Jour. Paleontology, v. 32, no. 6, p. 1153-57, 3 figs., Nov. 1958.

Rhiniopora spooneri, n. sp., from Upper Cretaceous rocks exposed at Rayburns dome, Bienville Parish, Louisiana, is the first representative of Rhiniopora reported from the N. American Cretaceous. The genus is common in Campanian and Maestrichtian deposits in Europe. --Auth.

1-113. Perry, T. G., and Donald E. Hattin. ASTOGENETIC STUDY OF FISTULIPOROID BRYOZOANS: Jour. Paleontology, v. 32, no. 6, p. 1039-50, fig., 3 pls., Nov. 1958.

The purpose of this study is to determine if structural changes took place during the astogeny of 3 species of fistuliporoid bryozoans. This investigation is based on Dybowskiella brownsportensis n. sp. and Fistulipora hemisphaerica (Roemer) from the Brownsport formation (Niagaran) of W.-central Tennessee and Cyclotrypa cf. C. abdita Moore & Dudley from the Beil limestone member of the Lecompton formation (Virgilian), Coffey County, Kansas. Thin sections were prepared to show structural conditions at different stages in the zoarial development of these species. The authors conclude that: (1) internal structures and characters commonly used in specific differentiation of fistuliporoids remain relatively constant during the astogeny of these species, (2) interzooecial (vesicular) tissue, as revealed in longitudinal section, commonly displays great structural variability within a single zoarium and seemingly has little value in differentiating fistuliporoid species, and (3) zoarial growth did not proceed uniformly in most of the zoaria studied. Comments are made concerning the relationship of the fistuliporoid genera Dybowskiella, Fistulipora, and Cyclotrypa. --Auth.

1-114. Amsden, Thomas W. STRATIGRAPHY AND PALEONTOLOGY OF THE HUNTON GROUP IN THE ARBUCKLE MOUNTAIN REGION. PT. 5, BOIS D'ARC ARTICULATE BRACHIOPODS: Oklahoma Geol. Survey, Bull. 82, 110 p., 18 figs., incl. illus., map, secs., fold. chart, 5 pls., Dec. 1958, 33 refs.

The Bois d'Arc formation consists of 2 members or lithofacies, a lower cherty, argillaceous calcilutite (Cravatt member) and an upper calcarenite (Fittstown member). Both the stratigraphic and faunal evidence indicate that these are facies of one another, and that the entire formation is a facies of the Haragan formation. The Bois d'Arc brachiopod fauna, consisting of 40 species (one new) referable to 32 genera, is described. This fauna is very similar to that of the Haragan, with 77% of the total Haragan-Bois d'Arc brachiopod species common to the 2 formations. The Haragan-Bois d'Arc fauna is Helderbergian in age and is closely related to the New Scotland fauna of New York. These strata are also believed to be equivalent to at least a part of the Ross formation (Linden group) of western Tennessee, and to the Bailey limestone of Missouri. --Auth.

1-115. Palmer, Katherine Van Winkle. TYPE SPECIMENS OF MARINE MOLLUSCA DESCRIBED BY P. P. CARPENTER FROM THE WEST COAST (SAN DIEGO TO BRITISH COLUMBIA): Geol. Soc. America, Mem. 76, 376 p., 35 pls., 1958.

Philip P. Carpenter ranks next to W. H. Dall and Paul Bartsch in the number of marine molluscan species described from the West Coast, San Diego to British Columbia. More than 270 Carpenter species, fossil and Recent, and many more names are involved in the present study. Illustrations of more than 190 types and of many original specimens with pertinent data are included. Only 4 of about 50 pelecypod species and only about one-fifth of the types of the gastropods have had the types figured previously. Authentic whereabouts of the types have been determined, lists regarding depositories of types, type localities, evaluation of names, analysis of available Carpenter material, and historical background have been included. Because Carpenter was one of the important figures in early American conchology, the historical background presents a partial picture of that time (*ca.* 1841-1870). The fossil distribution of each Recent species where known is included. A stratigraphic distributional chart is inserted. This reveals the relationship between the fauna of the Miocene, Pliocene, Pleistocene, and Recent species of the area studied. The importance of the illustration of the large number of heretofore unfigured types of common species, fossil and Recent, may be reflected in more refined taxonomic, ecological and paleoecological, statistical, and distributional studies of the late Cenozoic mollusks. --Auth.

1-116. Taylor, Dwight W. GEOLOGIC RANGE AND RELATIONSHIPS OF THE FRESHWATER SNAIL *ANISUS PATTERSONI*: Jour. Paleontology, v. 32, no. 6, p. 1149-53, Nov. 1958.

The freshwater snail heretofore known as *Gyraulus pattersoni* is the first late Cenozoic representative of the Old World genus *Anisus* to be recognized in America. Its known range now includes the middle Pliocene and late Pleistocene, as well as the early Pleistocene to which it was originally believed restricted. --Auth.

1-117. Unklesbay, A. G., and Ernest J. Palmer. CEPHALOPODS FROM THE BURGNER FORMATION IN MISSOURI: Jour. Paleontology, v. 32, no. 6, p. 1071-75, 2 figs., pl., Nov. 1958.

The cephalopod fauna from the Burgner formation in southwestern Missouri contains goniatites referable to *Pseudoparalegoceras williamsi* Miller & Downs. The presence of this species tends to confirm an Atokan age assignment for the Burgner. Nautiloids are also present but are not diagnostic. One new species, *Temnocheilus searighti* is described. --Auth.

1-118. Clark, David L. *ANISOCERAS* AND *ANCYLOCERAS* FROM THE TEXAS CRETACEOUS: Jour. Paleontology, v. 32, no. 6, p. 1076-81, fig., 2 pls., Nov. 1958, 25 refs.

Anisoceras and *Ancyloceras* have been confused for a number of years in the literature concerning lytoceratids in the Texas Cretaceous. Study of these genera shows that *Ancyloceras* ranges from the Upper Barremian to the Lower Aptian and can be distinguished by its trituberculate ribs from *Anisoceras* which is restricted to Upper Albian to Upper Turonian beds and has bituberculate ribs. The final straight shafts of these genera are similar in shape, but the fossils are not closely related as *Ancyloceras* coils in one plane in its youthful stages, whereas *Anisoceras* shows early helical coiling.

Reexamination of the genera reported indicates that no valid *Ancyloceras* has been described from Texas. Three species of *Anisoceras* are known: *A. bendirei* (Adkins), *A.* cf. *A. armatum* (Sowerby), and *A. salei* Clark, n. sp. --Auth.

1-119. Shimanskiy, V. N. O NEKOTORYKH SLUCHAYAKH KONVERGENTSII U NAUTILOIDEY [SEVERAL INSTANCES OF THE CONVERGENCE IN NAUTILOIDEA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 157-58, 1958.

Resume of lecture given Feb. 21, 1958. Convergence is one of the basic difficulties in systematics. This is especially the case with fossil material, where the number of identifying characteristics have been greatly reduced. The author mentions existing similarities between nautiloidea and ammonoidea found in beds of the Ordovician and Devonian periods. Even more complicated are homeomorphologic phenomena, which can be subdivided into: 1) monomorphism; 2) paramorphism; 3) isomorphism. The study of ontogeny shows considerable differences in the evolution of Paleozoic and the majority of Mesozoic nautiloidea. --LC

1-120. Tasch, Paul. NOVOJILOV'S CLASSIFICATION OF FOSSIL CONCHOSTRACANS - A CRITICAL EVALUATION. PART I. FAMILY LEAIIDAE: Jour. Paleontology, v. 32, no. 6, p. 1094-1106, 33 figs., Nov. 1958.

In 1956, Tasch set forth 3 principles for use in the classification of fossil conchostracans. Two additional principles are here formulated and illustrated. *Principle 4* states that a broad range of shell outline is to be expected in populations of living and fossil conchostracans referable to the same genus. Therefore genera erected on the basis of one or few specimens, where shell outline is the primary distinction, are invalid. *Principle 5* states that reassignments of genera and species based only on inadequate descriptions and illustrations by the original author are of doubtful value and should be considered invalid.

Utilizing the 5 principles now established, Novojilov's classification of fossil conchostracans is critically examined. Such analysis shows the 10 subfamilies erected by Novojilov to be largely based on genera shown to be synonyms of existing genera. All 10 subfamilities, Laeiinae, Cycloleaiinae, Lioleaiinae, Amphikoilinae, Monoleiolophinae, Hemicycloleaiinae, Igorvarentsoviinae, Rostroleaiinae, Praeleaiinae, and Esteriellinae are therefore rejected.

Similarly the genera, *Dolicholeaia* Novojilov, Leainella Novojilov, *Kaltanleaia*, Novojilov, *Mimoleaia* Novojilov, *Brachiorrhynchia* Novojilov, *Australoleaia* Novojilov, *Gonioleaia* Novojilov, *Bileaia* Kobayashi, *Tataroleaia* Novojilov, *Symmetroleaia* Novojilov, *Kargalia* Novojilov, *Lioleaia* Novojilov, *Lioleaiina* Novojilov, *Jaxartus* Novojilov, *Inkus* Novojilov, *Siberoleaia* Novojilov, *Igorvarentsovia* Novojilov, *Falsirostria* Novojilov, *Granirostria* Novojilov, *Teiichium* Novojilov, *Mesoleaia* Kobayashi, *Pseudoestheriella* Novojilov, *Tancrediella* Novojilov, and *Palermisca* Novojilov are rejected. --Auth.

1-121. Holland, F. D., Jr., and Alan M. Cvancara. CRABS FROM THE CANNONBALL FORMATION (PALEOCENE) OF NORTH DAKOTA: North Dakota Geol. Survey, Misc. Ser. no. 11, 12 p., 2 figs., pl., 1958. Repr. from Jour. Paleontology, v. 32, no. 3, May 1958.

More than 50 specimens of fossil crabs collected from the Cannonball formation (Paleocene) of southern Morton and Burleigh Counties, S.-central North Dakota form the basis for the first report of fossil crustaceans in North Dakota. The new genus *Camarocarcinus* is created for their reception, with the new species *C. arnesoni* as the type species. A separate, single, large propodus is placed in a new species, *Ranina (?) burleighensis,* by the senior author. The mode of occurrence suggests a near-shore condition of the Cannonball sea in this part of North Dakota. --Auth.

1-122. Kjellesvig-Waering, Erik N. THE GENERA, SPECIES AND SUBSPECIES OF THE FAMILY EURYPTERIDAE, BURMEISTER, 1845: Jour. Paleontology, v. 32, no. 6, p. 1107-48, 27 figs., 6 pls., Nov. 1958, approx. 200 refs.

A synopsis, review and reclassification of all eurypterids referred to the family Eurypteridae, Burmeister, 1845. Four genera, Eurypterus, Onychopterella, Erieopterus n. gen., and Tylopterella are recognized, and all species are reclassified. One new species and 3 new subspecies are described, and additional specimens and morphological details hitherto unknown are discussed. A complete check-list and bibliography of the family are included. --Auth.

1-123. Vyushkov, B. P. OB EKOLOGII ANOMODONTOV [ON THE ECOLOGY OF ANOMODONTS]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 154-55, 1958.

Resume of lecture given Dec. 3, 1957. The author describes various species of anomodontes and their former occurrence in different parts of the world. --LC

1-124. Amstutz, G. C. COPROLITES: A REVIEW OF THE LITERATURE AND A STUDY OF SPECIMENS FROM SOUTHERN WASHINGTON: Jour. Sed. Petrology, v. 28, no. 4, p. 498-508, 3 figs., Dec. 1958, 63 refs.

The term coprolite was found to be defined in many different ways, and this led to a review of the pertinent literature on the subject, with special reference to composition, origin, and geological significance of these petrified animal excrements.

Coprolites from southern Washington, collected from the bed of Salmon Creek, range from 0.5 to 10 cm. in diameter. Their mineralogical and chemical composition was established by microscopic, chemical, X-ray, and spectrographic analyses and found to be almost exclusively siderite with traces of limonite. We thus have a perfect example of complete replacement, since the shapes do not leave any doubt as to their true animal excrement origin. --Auth.

1-125. Hiltermann, Heinrich. ANNOTATED BIBLIOGRAPHY OF MICROPALEONTOLOGY IN GERMANY FOR 1957: Micropaleontology, v. 4, p. 431-38, Oct. 1958.

One hundred and one papers on all aspects of micropaleontology are listed and briefly reviewed. --Auth.

1-126. Burckle, Lloyd H. A FURTHER USE OF THE FOOD COLORING TECHNIQUE IN MICROPALEONTOLOGY: Compass, v. 36, no. 1, p. 49, Nov. 1958.

On fenestellid bryozoans, structures to be measured, such as the nodes and zooecia, can be seen more clearly when treated with colored food dye. Dye technique was also applied with success to the foraminifera. With trilobites, initial results were far inferior to those obtained with India ink. When dye was applied to the rough side of cellulose peels of fossil leaves, surface structure could be seen more easily.

In preparing the forms, a drop of food dye was placed on a watch glass, allowed to dry, and then applied to the form with a moist brush. Red or green dye will give the same results, but red is preferred as it can be photographed. --A. C. Sangree

1-127. Jones, Daniel John. DISPLACEMENT OF MICROFOSSILS: Jour. Sed. Petrology, v. 28, no. 4, p. 453-67, 12 figs., Dec. 1958.

The phenomena of horizontal and vertical displacement of microfossils are re-examined in the light of their increasing importance in correlation work and in paleoecologic studies. Size ranges of the common micropaleontological objects are tabulated and classified in terms of Wentworth's grade scale of sedimentary particles. The following types of displacement are discussed, and examples of each are cited:

I. Natural displacement
  A. Vertical displacement
    1. Older fossils into younger beds (redeposition)
    2. Younger fossils into older beds (stratigraphic leak)
  B. Horizontal displacement (environmental mixing)
    1. Intracontinental displacement
    2. Intramarine displacement
    3. Displacement between marine and continental environments
II. Artificial displacement (contamination)
  A. Displacement during sampling operations
  B. Displacement in the laboratory

The principal agents of natural displacement are waves and currents, running water, ground water, wind, glacial ice, and organisms of various types. Vertical displacement is most significant in the use of microfossils for stratigraphic work, whereas horizontal displacement must be taken into account in paleoecological investigations. Possible criteria for recognition of displaced microfossils are listed and discussed. --Auth.

1-128. Elliott, Graham F. FOSSIL MICROPROBLEMATICA FROM THE MIDDLE EAST: Micropaleontology, v. 4, no. 4, p. 419-28, 3 pls., Oct. 1958.

Three problematic microfossils from the Middle East are described as new: Pseudovermiporella sodalica from the Permian, Aeolisaccus dunningtoni from the Permian, Triassic, and Jurassic, and Lacrymorphus perplexus from the Triassic. It is suggested that Aeolisaccus may be a pteropod, and the other two algae. --Auth.

1-129. Stelck, C. R., J. H. Wall, and R. E. Wetter. LOWER CENOMANIAN FORAMINIFERA FROM PEACE RIVER AREA, WESTERN CANADA: Research Council Alberta, Geol. Div., Bull 2, pt. 1; Warren, P. S., and C. R. Stelck, LOWER CENOMANIAN AMMONOIDEA AND PELECYPODA FROM PEACE RIVER AREA, WESTERN CANADA: Research Council Alberta, Geol. Div., Bull. 2, pt. 2; 51 p., illus., 1958, approx. 40 refs.

Part I

Sixteen species and subspecies of Foraminifera -

one of which is named - from the Lower Cenomanian portion of the St. John and Dunvegan formations of the Peace River area, Western Canada, are figured and described. Microfaunal assemblages are integrated with local megafaunal sequences of the Lower Cenomanian substage of the Upper Cretaceous. Lithologic sections are given for the Lower Cenomanian strata in the Fort St. John area. The Lower Cretaceous-Upper Cretaceous boundary occurs at a fish-scale sand marker-bed in the Shaftesbury formation in outcrop. Correlative fish-scale beds are found in the lower part of the Colorado shale of Alberta and Saskatchewan, and in the Mowry shale of the Black Hills area of the United States.

The foraminiferal assemblages are dominantly arenaceous. Micro- and macrofauna indicate a progressive change from a relatively deep, cool, euxinic, normally saline environment to shallow, brackish and fresh, deltaic conditions.

Part II

Nine species of Cenomanian ammonities and 6 of pelecypods are described and figured from the Peace River area of Western Canada. Two new ammonite genera, Beattonoceras and Irenicoceras are proposed; 4 new ammonite species and 3 pelecypod species are named. --Auth.

1-130. Graham, Joseph J., and Priscilla Militante, Jr. RECENT FORAMINIFERA FROM THE PUERTO GALERA AREA, NORTHERN MINDORO, PHILIPPINES: Stanford Univ., Pubs., Geol. Sci., v. 6, no. 2, 174 p., 2 figs., 19 pls., Feb. 1959.

During a 3-week period in Apr. and May, 1955, 60 sediment samples were collected from tropical shallow waters (intertidal to 20 fathoms) of Puerto Galera and Varadero bays, the Balateros region, and Markoe and Sabang coves in the northern sector of the island of Mindoro in the N.-central Philippines. These were examined for their foraminiferal content as part of the long-range project of the Univ. of the Philippines Marine Biological Station, which has as its objective a general survey of the various kinds of microorganisms in this part of the Pacific Basin.

From 60 stations (bay, cove, channel, and beach localities) were obtained 264 species and varieties of Foraminifera distributed among 122 genera in 22 calcareous and 11 arenaceous-agglutinated families. Among the forms with a calcareous test, the Miliolidae show the largest number of species and varieties (75), followed by the Rotaliidae and Buliminidae, each with 34; of those with an arenaceous-agglutinated test, the Textulariidae are best represented, with 11 species and varieties.

Most of the Puerto Galera foraminifers are referred to forms previously recorded from the Philippine and other tropical Pacific and Indo-Pacific waters, although a few are indeterminate as to species. None is described as new. Ninety-six % of the fauna is benthonic, and only 4% is planktonic. Except for varying abundance, there is little diversity among the species comprising the various assemblages.

According to our investigations, variations in temperature, salinity, and depth of water are so small that it is doubtful whether these influence the composition of the assemblage and the distribution and relative abundance of individual benthonic forms to any great extent. Of more importance apparently is the nature of the sediment type, inasmuch as a markedly richer population per species is found in silt and very fine sand than in coarser materials.

Tables and text figures show a list of the Foraminifera, collecting localities, bathymetric arrangement of stations, percentage composition of faunal assemblages, abundance of species and varieties, number of forms common to the various regions, and range of bottom and surface temperatures and salinities, as well as other ecological data.

All species and varieties of Foraminifera determined are illustrated in the accompanying 19 plates. Synonymy for most forms has been kept to a minimum. To a certain extent the interrelationship of a species (or variety) with its substratum is emphasized. --Auth.

(May be purchased from: Publications Committee, Geology Dept., Stanford University, Stanford, Calif. Price: $3.00)

1-131. Stewart, Wendell J. SOME FUSULINIDS FROM THE UPPER STRAWN, PENNSYLVANIAN, OF TEXAS: Jour. Paleontology, v. 32, no. 6, p. 1051-70, 2 figs. incl. map, 6 pls., Nov. 1958.

The new genera and species Plectofusulina franklinensis and Frumentella exempla with the new species Fusulina vintonensis are described from the upper Magdalena formation in the Franklin Mountains, El Paso County, Texas. The new species Paramillerella dogbendensis, Fusiella texana, Fusulina whitakeri, F. brazosensis, F. valida, F. bellatula, F. gordonensis and F. cappsensis are from the Capps, East Mountain Shale, and Garner formations of the upper Strawn exposed along the Colorado and Brazos river drainage areas of Palo Pinto, Eastland and Brown counties, Texas.

The new species Fusiella texana was found stratigraphically higher than the most advanced forms of Fusulina and is the first true recognition of this genus in America.

These fusulinids occur above the recognized zone of Wedekindellina and below the zone of Triticites in Texas and are considered to be upper Strawn.--Auth.

1-132. Colom, Guillermo. THE AGE OF THE BEDS WITH MIOGYPSINA MEDITERRANEA BRONNIMANN ON THE ISLAND OF MAJORCA: Micropaleontology, v. 4, no. 4, p. 347-62, 4 figs., Oct. 1958.

The structural and stratigraphic geology of the island of Majorca is outlined in order to show the stratigraphic positions in the Lower and Middle Miocene occupied by the foraminiferal species cited in the text. Discordance exists between the Lower Miocene (Burdigalian) and the Middle Miocene (Helvetian-Tortonian). In the Burdigalian, Miogypsina mediterranea is associated with foraminifera of "Caribbean" type which are frequent in the "Upper Oligocene" and Lower Miocene of Central America, as well as in the Balearic Islands. In the Helvetian-Tortonian, other associations, which are very different from these but which are frequent in the Middle and Upper Miocene and Pliocene of the Mediterranean zone, are found. Miogypsina has not previously been observed in the Helvetian-Tortonian of Majorca. --Auth.

1-133. Mohan, Krishna. MIOGYPSINIDAE FROM WESTERN INDIA: Micropaleontology, v. 4, no. 4, p. 373-90, 7 figs., 3 pls., Oct. 1958.

The principles of classification of the Miogypsinidae are discussed. Two new species, *Miogypsina (Miogypsina) bhogatensis* Mohan and *Miogypsina (Lepidosemicyclina) droogeri* Mohan and Tiwari, are described, and the subgenus *Lepidosemicyclina* Rutten, 1911, is reinstated. --Auth.

1-134. Klapper, Gilbert. AN UPPER DEVONIAN CONODONT FAUNA FROM THE DARBY FORMATION OF THE WIND RIVER MOUNTAINS, WYOMING: Jour. Paleontology, v. 32, no. 6, p. 1082-93, 2 pls., map, Nov. 1958, 49 refs.

The upper part of the Darby formation at 2 localities in the Wind River Mountains, Fremont County, Wyoming, has yielded a fairly well-preserved Upper Devonian conodont fauna. The Darby formation has not previously been the subject of a detailed paleontological study. Approximately 40% of the specimens are referable to the genera *Polygnathus* and *Spathognathodus*. The genera *Palmatolepis*, *Icriodus*, and *Apatognathus*, which are characteristic of the Upper Devonian, are also represented. Three species are new: *Icriodus darbyensis*, *Icriodus mehli*, and *Polygnathus wyomingensis*. This fauna is considered to be contemporaneous with part of the Saverton shale fauna of Missouri. In the past the Saverton fauna has been mistakenly referred to the Grassy Creek shale. The Darby fauna is tentatively correlated with zone V (*Clymenia*-Stufe) of the Famennian stage in Germany. --Auth.

1-135. Rexroad, Carl B. THE CONODONT HOMEOMORPHS TAPHROGNATHUS AND STREPTOGNATHODUS: Jour. Paleontology, v. 32, no. 6, p. 1158-59, Nov. 1958.

Taphrognathus is limited to the Valmeyer series, while *Straptognathodus* ranges upward from the uppermost part of the Chester series. *Cavusgnathus* developed from *Taphrognathus* during late Valmeyer time and in turn gave rise to the early species of *Streptognathodus*, a genus homeomorphic with *Taphrognathus*. Such cases of homeomorphy among conodonts probably are numerous, and their recognition will aid greatly in stratigraphic interpretation. --Auth. summ.

1-136. Morris, Robert W. A NEW CONCEPT IN OSTRACOD TAXONOMY: Micropaleontology, v. 4, no. 4, p. 341-46, 8 figs., Oct. 1958.

A more complex system of nomenclature is necessary to reflect adequately the complexity and high degree of specialization in the cytherid ostracods. Several new generic criteria are proposed for certain major groups of Cytheracea. The basic concepts involved are probably applicable to most cytherids. All of the structures considered lie on the ventral surface of the carapace. --Auth.

1-137. Marianos, Andrew W., and James W. Valentine. EOCENE OSTRACODE FAUNA FROM MARYSVILLE BUTTES, CALIFORNIA: Micropaleontology, v. 4, no. 4, p. 363-72, 4 figs., 2 pls., Oct. 1958.

An ostracode fauna of 11 species is described from the Eocene Capay formation at Fig-Tree Gulch, Marysville Buttes, California. One species is considered to be conspecific with a Gulf Coast form, one is described as a *nomen apertum*, and 9 are new. The genera *Cytherella*, *Bythocypris*, *Buntonia*, *Paijenborchella*, *Munseyella*, *Trachyleberis*, *Trachyleberidea*, and *Actinocythereis* are represented. The most noteworthy generic occurrence is that of *Paijenborchella*, hitherto unreported from the Western Hemisphere. --Auth.

1-138. Van Den Bold, W. A. OSTRACODA OF THE BRASSO FORMATION OF TRINIDAD: Micropaleontology, v. 4, no. 4, p. 391-418, 2 figs., 5 pls., Oct. 1958.

Sixty-two species of Ostracoda have been recorded from the Brasso formation of central Trinidad. One genus, 10 species, and one subspecies are described as new. The upper part of the Brasso formation is tentatively correlated with beds of the Choctawhatchee stage in Florida. --Auth.

1-139. Guennel, G. K. MIOSPORE ANALYSIS OF THE POTTSVILLE COALS OF INDIANA: Indiana Geol. Survey, Bull., 13, 101 p., 20 figs., 6 pls., 1958, 45 refs.

Ninety-eight coal samples were collected for this study at 85 localities in 12 Indiana counties. Percentage relationships of miospore genera and relative abundances of species were determined for these samples and can be used successfully in correlating coal beds within the Pottsville series (Pennsylvanian).

Two formations, the Mansfield and the Brazil, constitute the Pottsville series in Indiana. Miospore analysis revealed 7 distinct spore assemblages for samples of coals from the Mansfield formation and indicates the need for further detailed study of these coals. Samples from the Brazil formation displayed 8 distinct assemblages. These spore patterns are useful for dividing the Brazil formation into 8 zones and indicate that the formation may have more coal seams than geologists have previously thought.

The Upper Block coal (Brazil formation) from Clay County has a pronounced abundance of the genus *Cirratriradites* and thus can be differentiated from the Lower Block coal (Brazil formation). Three distinct spore patterns were obtained from coals presumably contemporaneous in deposition with Lower Block coal. The 3 zones are thought to represent 3 coals in stratigraphic sequence. The lower coal seam, high in *Laevigatosporites*, is called Lower Block a zone; the middle seam, characterized by a dual dominance of *Lycospora* and *Laevigatosporites*, is called Lower Block b zone; and the upper seam, high in *Densospirites*, is called the Lower Block c zone.

Three distinct spore patterns also were obtained from coals presumably contemporaneous in deposition with Upper Block coal. The 3 zones are thought to represent 3 coals in stratigraphic sequence. The lower coal seam, marked by a pronounced *Cirratriradites* peak, is called Upper Block a zone; the middle seam, dominated by *Laevigatosporites*, *Granulatisporites*, and *Endosporites*, is called Upper Block b zone; and the upper seam, completely dominated by *Laevigatosporites*, is called Upper Block c zone.

A comparison of generic abundance graphs of Indiana and Illinois coals reveals some striking generic hemerae. For example, the spore assemblage of the Pinnick coal (Mansfield formation) of Indiana is similar to the spore patterns of the Battery Rock and Reynoldsburg coals (Caseyville group) of Illinois. *Cirratriradites* hemerae are found in the Tarter and Willis coals of Illinois and in the Upper Block a zone of Indiana. A pronounced Endosporites peak can be seen in the Minshall coal (Brazil formation) of Indiana and may be correlative with a similar peak in the Seville, Rock Island, Curlew, and Bald Hill coals of Illinois.

The classificatory system of Schopf, Wilson, and Bentall was used in this study. The 13 prominent miospore genera of the Pottsville coals, classified according to this system, also are equated with the Potonie and Kremp taxa. The 12 new species described and figured are: Cirratriradites arcuatus, Cirratriradites foveatus, Endosporites parvus, Endosporites circularis, Endosporites breviradiatus, Leiotriletes parvus, Pustulatisporites crenatus, Calamospora parva, Triquitrites bucculentus, Reticulatisporites annulatus, Reticulatisporites areolatus, and Alatisporites pottsvillensis. --Auth.

1-140. Korde, K. B. SISTEMATICHESKOYE POLOZHENIYE I STRATIGRAFICHESKOYE ZNACHENIYE RODA EPIPHYTON [THE SYSTEMATIC STATUS AND STRATIGRAPHICAL IMPORTANCE OF THE SPECIES EPIPHYTON]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 156-57, 1958.

Resume of lecture given Feb. 21, 1958. Specimens of the species Epiphyton were first found in Cambrian deposits on the island of Sardinia by Bornemann in 1885-1886. Later they were found in Cambrian deposits of the Antarctic, in France and in the Soviet Union. The author disagrees with several scientists who compare the Epiphyton with Ortonella or Solenopora. Its cellular structure and porosity (found at the lateral walls of cells), permitted Epiphyton to be classified as belonging to red algae, of the class Florideae. The study of the material from Cambrian deposits of the Lena, Buotama, Mukhatta, Sinyaya, Amga and Aldan rivers, in comparison with adjacent geosycline regions, permitted important stratigraphic correlations to be made. --LC

1-141. Richards, Horace G., and others. THE CRETACEOUS FOSSILS OF NEW JERSEY, PART I: Trenton, N.J., New Jersey Bur. Geology & Topography, 266 p., 46 pls., 1958.

The work is in part an up-to-date revision of the 1907 Cretaceous Paleontology of New Jersey, by S. Weller; other parts are entirely rewritten by specialists. --K. Widmer.

In addition to several introductory chapters, largely by H. G. Richards and Robert C. Ramsdell, the book includes the following sections: Porifera (Sponges), by B. F. Howell; Coelenterata (Corals), by John W. Wells; Annelida (Worms), by B. F. Howell; Echinoids (Sea Urchins), by C. Wythe Cooke; Brachiopoda, by H. G. Richards; Pelecypoda (Clams, etc.), by H. G. Richards.

The book is well illustrated and should be valuable for the identification of Cretaceous fossils to both the professional and amateur paleontologist. A summary of the latest work on stratigraphy and correlation is also given. --H. G. Richards.

6. GEOPHYSICS

See also: Geologic Maps 1-17 to 1-25, 1-49; Structural Geology 1-89.

1-142. Dooley, J. C. CENTENARY OF MELBOURNE-TOOLANGI MAGNETIC OBSERVATORY: Jour. Geophys. Research, v. 63, no. 4, p. 731-35, Dec. 1958.

A brief history of the Melbourne-Toolangi Magnetic Observatory [Australia] is given, on the occasion of its hundredth year of continuous operation. --Auth.

1-143. Kaula, W. M. GRAVITY FORMULAS UTILIZING CORRELATION WITH ELEVATION: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1027-33, Dec. 1958.

Solutions for the first 2 terms of the standard gravity formula $\gamma\ (1 + \beta \sin^2 \phi)$ were made, all based on the assumption that the gravity anomalies in areas without observations will average the same as observed values of the same elevation. The solution by the method considered theoretically best yields

$$\gamma = (978040.4 \pm 1.3)[1 + (0.0053014 \pm 0.0000030) \sin^2 \phi - 0.0000059 \sin^2 2\phi],$$

and

$$f = 1/298.15 \pm 0.26$$

The coefficients of the fourth and sixth degree zonal harmonics were also computed and used to estimate how much a flattening found from satellite motion would differ. For example, it is estimated that an orbit approximating that of 1958 β would give $f = 1/298.00$. --Auth.

1-144. Raja Rau, K. S., and K. R. Sivaraman. LUNAR GEOMAGNETIC TIDES AT KODAIKANAL: Jour. Geophys. Research, v. 63, no. 4, p. 729-30, fig., Dec. 1958.

Following the mathematical development of Chapman and Miller, Tschu has described a practical method of determining the lunar diurnal variation of geophysical elements. By the application of Tschu's method, the lunar semi-diurnal variation of the horizontal intensity of earth's magnetic field at Kodaikanal [India] in the geomagnetic equatorial region is worked out for the winter solstice by making use of the hourly values of the horizontal intensity for the period 1950 to 1954.

The expression $\Delta H - 3.32 \sin (2\tau - 39^{\circ}\ 0.04') \gamma$ is obtained for the lunar semi-diurnal wave. A graph of ΔH against the age of the moon is drawn. From the graph, it is seen that the amplitude of the lunar geomagnetic tide is maximum when the sun and the moon are 135° apart. The solar diurnal variation is also determined up to four harmonics. --Auth.

1-145. Nicholson, Seth B., and Oliver R. Wulf. THE DIURNAL VARIATION OF IRREGULAR GEOMAGNETIC FLUCTUATIONS-II. Jour. Geophys. Research, v. 63, no. 4, p. 803-806, Dec. 1958.

Using the 8 daily K numbers (3-hour-range indices) for 6 observatories in moderately low latitudes and fairly well distributed in longitude, a universal-time component of the daily variation of irregular geomagnetic fluctuations having an apparently significant amplitude in the yearly average has been found in the data for the 9 years, 1940-1948. It is suggested that a portion of magnetic disturbance may be produced by dynamo action in the ionosphere and give rise to this yearly-average universal-time component. --Auth.

1-146. Kato, Y., and T. Watanabe. STUDIES ON GEOMAGNETIC STORM IN RELATION TO GEOMAGNETIC PULSATION: Jour. Geophys. Research, v. 63, no. 4, p. 741-56, 4 figs., Dec. 1958, 36 refs.

The existence of the earth's outer atmosphere, of which hydromagnetic oscillations, forced by the corpuscular stream, would give rise to geomagnetic pulsations, suggests the usefulness of studying the geomagnetic storm in relation to the geomagnetic pulsation, and, further, of improving the Chapman-Ferraro theory of the geomagnetic storm. The sudden commencement should be described as the compression of the outer-atmospheric matter due to the corpuscular stream. A speculation is given to picture the main phase field as the hydromagnetic rotation of the outer atmosphere. The structure of the solar corpuscular stream responsible for the 27-day recurring magnetic disturbance can be modeled well by Pecker-Roberts' "cone of avoidance" structure, which is favored by both magnetic and cosmic-ray phenomena. The sporadically occurring geomagnetic storm (the S type) corresponds to the corpuscular stream with the shock front formed in the interplanetary matter. The determining of the storm-time variation of the activity of the geomagnetic pulsation (the pc type) assists in conjecturing the structure of the corpuscular stream. --Auth.

1-147. Hines, C. O., and L. R. O. Storey. TIME CONSTANTS IN THE GEOMAGNETIC STORM EFFECT: Jour. Geophys. Research, v. 63, no. 4, p. 671-82, fig., Dec. 1958.

This paper is a contribution to the ring-current theory of geomagnetic storms. It is concerned with estimating the delay that may elapse, due to the shielding effect of the conducting medium in the outer ionosphere, between the formation of the ring current and the occurrence of the resulting geomagnetic storm at the earth's surface. A previous estimate had placed this delay time as high as several months. However, it is shown that if proper account is taken of the fluidity of the medium and of the presence of the main geomagnetic field, the anticipated delay becomes so small that it no longer provides a basis for an objection to the ring-current hypothesis. --Auth.

1-148. Parker, E. N. INADEQUACY OF RING-CURRENT THEORY FOR THE MAIN PHASE OF A GEOMAGNETIC STORM: Jour. Geophys. Research, v. 63, no. 4, p. 683-89, fig., Dec. 1958.

It is demonstrated that there is apparently not enough dissipation to allow significant diffusion, during a magnetic storm, of the magnetic fields in the vicinity of the earth. It is then demonstrated that a ring-current field can only increase the horizontal component of the geomagnetic field, and so cannot account for the main phase of a geomagnetic storm. Thus, other storm mechanisms must be sought. --Auth.

Essential points of difference between this paper and the preceding paper by C. O. Hines and L. R. O. Storey are clarified through the use of diagrams in a note by Hines and Parker: STATEMENT OF DIFFERENCES REGARDING THE RING-CURRENT EFFECT. Jour. Geophys. Research, v. 63, no. 4, p. 691-92, 3 figs., Dec. 1958.

1-149. Shaub, Benjamin M. MAGNETIC ANOMALIES OF THE TICONDEROGA, N. Y., QUADRANGLE: New York State Mus. & Sci. Service, Geol. Survey, [unpub. rept.], 11 p., 19 dip needle maps, scale from 1 in. to 200 ft. to 1 in. to 700 ft., Oct. 1958.

Dip needle surveys were made abstract in the Ticonderoga quadrangle, W. of Lake Champlain, of the anomalies found by the U.S. Geological Survey's airborne survey of 1946. Results are presented on large scale maps. All anomalies are associated with previously known magnetite occurrences. Most promising anomalies are the Breeds Hill and Vineyard deposits although a number of others may contain rather sizable tonnage of ore of grades not commercial at present.

Host rocks are granitic gneisses and pegmatitic phases thereof. S is common in the deposits and in a few it comprises as much as 10 to 15% of the ore minerals. Ti where it is measured is present in the order of 1/10% of the combined ore-Ti content. --Y. W. Isachsen

1-150. Henderson, John R., Jr., and Isidore Zietz. INTERPRETATION OF AN AEROMAGNETIC SURVEY OF INDIANA: U. S. Geol. Survey, Prof. Paper 316-B, p. 19-37, figs. 6-16, pls. 4-5, total-intensity aeromagnetic map, scale 1:500,000, Nov. 1958.

An aeromagnetic survey of Indiana was conducted in 1947, 1948, and 1950 by the U. S. Geological Survey in cooperation with the State of Indiana. The Survey has published 92 county aeromagnetic maps on a scale of 1 in. to 1 mi. with a contour interval of 10 gammas.

These maps have been combined into one on a scale of 1:500,000 and a 50-gamma contour interval to form a regional map of the State. The aeromagnetic map has been studied in combination with a regional gravity map prepared by the Indiana Geological Survey. Most wells drilled to date (1955) have been relatively shallow, and geologic information below the Trenton limestone of Middle Ordovician age has been sparse. The existance of a detailed and accurate aeromagnetic survey of the State made it possible to prepare a regional contour map of the buried Precambrian crystalline surface. This was done by analyzing 79 isolated well-defined magnetic anomalies and determining the depths at these locations. The topographic trends on the Precambrian basement rocks are in general similar to the structural trends on top of the Trenton limestone. There is also excellent agreement between the basement map and the depths to basement rocks determined by deep-well drilling. In the NE. corner of the State, the basement contours indicate the possible existence of a major NW.-trending ridge about 50 mi. wide which does not appear on the structure map on top of the Trenton limestone. The existence of this ridge is partly confirmed by large gravity and magnetic anomalies at almost the same place. Seismic-reflection profiles also tend to confirm the existence of the postulated structure.

Maps showing the location of oil and gas wells have been compared with the larger aeromagnetic anomalies in several counties. A good correlation seems evident in Harrison County in southern Indiana, but in the southwestern part of the State most oil wells seem to be located along the flanks of the major magnetic anomalies. --Auth.

1-151. Meidav, Tsvi, William C. Hayes and George E. Heim. RESISTIVITY SURVEYS OF MISSOURI LIMONITE DEPOSITS: Missouri Div. Geol. Survey & Water Resources, Rept. Inv. no. 24, 27 p., 16 figs. incl. geol. map, 1958.

The high cost in money and time of present exploration methods for secondary brown iron deposits invites investigation of alternate methods, one of which is the application of electrical resistivity.

The geologic conditions of Missouri deposits are adaptable to this type of exploration because they are residual accumulations of clay, chert, altered pyrite, and marcasite that are concentrated in sinkholelike depressions in dolomitic bedrock. Methods of continuous profiling and depth probing establish the presence and limits of the sink structures by determination of depth to bedrock. Empirical differentiation of surface limonite concentration from cherty residuum is possible. --Auth.

1-152. De Noyer, John. DETERMINATION OF THE ENERGY IN BODY AND SURFACE WAVES (PART II): Seismol. Soc. America, Bull., v. 49, no. 1, p. 1-10, Jan. 1959.

Part II of this paper is concerned with the application of the methods for estimating the energy in seismic waves that were presented in Part I. Numerical results for the energy in the various phases of several earthquakes have been obtained. --Auth.

1-153. Sato, Yasuo. NUMERICAL INTEGRATION OF THE EQUATION OF MOTION FOR SURFACE WAVES IN A MEDIUM WITH ARBITRARY VARIATION OF MATERIAL CONSTANTS: Seismol. Soc. America, Bull., v. 49, no. 1, p. 57-77, 11 figs., Jan. 1959.

The calculation of surface-wave dispersion is difficult when the waves propagate in media whose physical properties change with depth, and only a few solutions are available for fairly simple cases.

These computations may now be performed with the aid of high-speed computers, even for media whose material constants change arbitrarily with depth. The dispersion of both Love waves and Rayleigh waves has been obtained for such cases by the numerical specification of surface displacement followed by numerical solution of the equations of motion.

For example, with respect to the problem of Love waves, besides the ordinary boundary condition that the stress vanishes at the free surface, an extra condition is stated which requires that the displacement amplitude be unity at the surface. The equation of motion is then solved numerically for tentative values of frequency and wave number, and this solution produces the distribution of displacement amplitude in the half space. For all combinations of frequency and wave number which are not solutions, the values of computed displacement do not converge and tend to become positively or negatively infinite for increasing depth below the free surface. To obtain a solution, one of the parameters - for instance, wave number - is fixed, and frequency is varied in small steps until the computed displacement converges to zero at great depths. This combination of parameters fulfills all the standard boundary conditions and is the required solution. The problem of sound waves in an elastic liquid can also be solved with only a minor change in the physical properties.

The dispersion of Rayleigh waves propagating in a heterogeneous substance can also be obtained by a similar method. In this case, another parameter is needed, namely, the ratio of the amplitude of horizontal and vertical components of displacement at the free surface. Denote this quantity by *a*, and the phase velocity by *c*. Wave number is fixed, and a two-dimensional search in the *a-c* plane is used to locate the point that produces a convergent solution. For limited media a solution is required which satisfies the boundary conditions at the other surface.

After testing the method by applying it to cases which had been solved analytically, a few problems were solved. These include:

1) Love waves in a medium with constant density and linearly increasing rigidity.
2) Sound waves in a medium whose density and velocity are given by experimental curves.
3) Rayleigh waves in a medium having constant density and equal rates of increase for λ and μ.

Using an IBM "650," it takes a few minutes to get a point for cases 1 and 2, and from 30 min. to 2 hours per point for Rayleigh-wave dispersion. --Auth.

1-154. Thomson, William T. SPECTRAL ASPECT OF EARTHQUAKES: Seismol. Soc. America, Bull., v. 49, no. 1, p. 91-98, 3 figs., Jan. 1959.

Considering ground acceleration associated with earthquakes to be composed of a series of velocity impulses of random amplitude, time spacing, and wave shapes, a statistical approach is used to establish its power spectral density. The general result indicates that if the mean of the velocity pulses is zero, the power spectral density becomes a constant, regardless of wave shape and time spacing, thereby supporting the equipartition of energy theory, first advanced by Housner. --Auth.

1-155. Willmore, P. L. THE APPLICATION OF THE MAXWELL IMPEDANCE BRIDGE TO THE CALIBRATION OF ELECTROMAGNETIC SEISMOGRAPHS: Seismol. Soc. America, Bull., v. 49, no. 1, p. 99-114, 6 figs., Jan. 1959.

It is shown that an electromagnetic seismograph may be calibrated by observing the deflections of the galvanometer when an electrical signal is injected through a suitable coupling circuit. A specially designed version of the Maxwell Impedance Bridge is used for this purpose, the seismometer being connected in one arm and the galvanometer across the output. The bridge is balanced when the seismometer is clamped. The seismometer is then unclamped, and the galvanometer starts to swing with an amplitude equal to that which would be produced by a ground acceleration proportional to the bridge current. The constant of proportionality is found by injecting a "substitution e.m.f." across the ratio arm of the bridge. By carrying out the substitution experiments in their most complete form it is possible to determine the mass, the suspension stiffness, and the damping constant of the seismometer, either including or excluding the effects of the galvanometer reaction. Typical calibration curves for Benioff, Willmore, and Sprengnether seismometers are included. --Auth.

1-156. Nuttli, Otto W. THE PARTICLE MOTION OF THE S WAVE: Seismol. Soc. America, Bull., v. 49, no. 1, p. 49-56, 7 figs., Jan. 1959.

A micrometer microscope has been used to obtain particle motion diagrams for the S phase re-recorded at Florissant for distances from 50° to 80°. The diagrams indicate that the particle motion is linear. Furthermore, the diagrams show that the SV and SH components arrive simultaneously. They also show that it is sometimes very difficult to obtain the sense of the first S motion from a simple visual inspection of the seismograms. --Auth.

1-157. Grossling, B. F. SEISMIC WAVES FROM THE UNDERGROUND ATOMIC EXPLOSION IN NEVADA: Seismol. Soc. America, Bull., v. 49, no. 1, p. 11-32, 19 figs., Jan. 1959.

Seismic waves from the underground atomic explosion of Sept. 19, 1957, were recorded for 45 min. on multichannel magnetic tape at a point 25 mi. N. of Holbrook, Ariz., about 370 mi. from their source. Twelve vertical-component seismometers were laid out in the form of an L 5,280 ft. by 1,600 ft. to permit determinations of apparent velocity and of direction of arrival. The frequency range recorded, about 6 to 40 cps., was higher than usual in earthquake seismology. During tape playback, supplementary filtering, gain adjustments, and changes in time scale served to improve the quality and legibility of the records.

The playback seismograms reveal strikingly well not only the P_n and P* waves transmitted and refracted by the crust, but also many others. Some of these, as clearly indicated by their directions of arrival, did not originate from the explosion. We have attempted only an elementary interpretation, our main purpose being to make the data available to anyone who might be interested in them. The relatively short wave lengths of the recorded events may make them of unusual significance. In addition to arrival times, we made a few measurements of absolute amplitude and of frequency spectra. --Auth.

1-158. Woollard, G. P. AREAS OF TECTONIC ACTIVITY IN THE UNITED STATES AS INDICATED BY EARTHQUAKE EPICENTERS: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1135-50, 7 figs. incl. 6 maps, Dec. 1958, 47 refs.

A study based on earthquake occurrences in the United States shows several zones of continuing seismic activity. Over the past 30 years there is a suggestion of systematic variations in seismic activity following what appears to be a 3-year cycle which is superimposed on a longer period. Areas of activity cannot be related to either geologic age or type of structure. In California transcurrent movement on known faults is associated with seismic activity. In the other western states, activity is associated with the boundaries of areas of epeirogenic uplift and subsidence and appears to involve predominantly vertical crustal displacement. In the Midcontinent area, activity for the most part is associated with positive crystalline rock tectonic elements and their borders. In the Appalachian area, activity is associated with the zones of overthrusts and shear. A conspicuous zone of earthquakes paralleling the Appalachians from Missouri to the St. Lawrence River valley, while not related to known geologic controls, does follow a zone of better-than-normal seismic transmissibility. The depth of focus varies from area to area and appears to be related directly to crustal thickness and possibly also [to] changes in crustal rigidity with depth. No direct relation is noted between areas of isostatic unbalance and seismic activity or variations in degree of seismic activity with changes in crustal thickness. For the most part, it appears [that] local stress conditions are dominant in causing earthquakes. --Auth.

1-159. Fraser, George D., Jerry P. Eaton, and Chester K. Wentworth. THE TSUNAMI OF MARCH 9, 1957, ON THE ISLAND OF HAWAII: Seismol. Soc. America, Bull., v. 49, no. 1, p. 79-90, 4 figs., Jan. 1959.

The Aleutian-born tsunami of March 9, 1957, produced water heights on the island of Hawaii between those produced by the 1946 and 1952 tsunamis. The tsunami-generating mechanism, although poorly understood, permits a hypothesis of multiple waves generated near the source (or the same wave traveling different paths) which eventually interfere to produce contrasting intensities in different parts of the broad Hawaiian area. Comparisons suggest that each tsunami is unique and unpredictable in some respects and predictable in others. Water heights depend in part on location and orientation of coastlines with respect to the earthquake epicenter and the presumed line along which the tsunami was generated. Local conditions of seiche and coastline configuration further modify average wave heights. Local conditions are effectively constant with respect to Aleutian tsunamis, and empirical data on water heights and danger areas are available. A program of improving tsunami and earthquake observations, together with additional tide-observation stations, may eventually permit more precise evaluation of a tsunami both before and after its arrival. --Auth.

1-160. Beck, Alan E., and Julia M. Beck. ON THE MEASUREMENT OF THE THERMAL CONDUCTIVITIES OF ROCKS BY OBSERVATIONS ON A DIVIDED BAR APPARATUS: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1111-23, 3 figs., Dec. 1958.

Rapid techniques for the preparation of disks of rock and for the determination of rock conductivities have been used to make a large number of measurements on both coarse-grained and fine-grained rocks. Methods in which either sets of disks or single disks can be used are described, and the mean values of conductivity found by combining the results in various ways are compared. The modes of the rocks were found by examination of thin sections for the fine-grained rocks and by examination of each disk for the coarse-grained rocks. Conductivities computed from the modes by the method of Birch and

Clark are compared with the experimentally determined conductivities. The significance of rock structure in the selection of representative specimens and the effect of moisture content in porous rocks is discussed. The work indicates that, at least for the coarse-grained rocks, the usefulness of the conductivities obtained from divided bar measurements can be seriously questioned, and that the usual methods of saturating porous rocks are not wholly satisfactory. --Auth.

7. GEOCHEMISTRY

See also: Geomorphology 1-69; Stratigraphy 1-110, 1-111; Mineralogy 1-191, 1-199; Igneous and Metamorphic Petrology 1-207; Sedimentary Petrology 1-217; Mineral Deposits 1-247, 1-248; Fuels 1-272.

1-161. Hirst, D. M., and G. D. Nicholls. TECHNIQUES IN SEDIMENTARY GEOCHEMISTRY: (1) SEPARATION OF THE DETRITAL AND NON-DETRITAL FRACTIONS OF LIMESTONES: Jour. Sed. Petrology, v. 28, no. 4, p. 468-81, 3 figs., Dec. 1958.

A method is outlined whereby the contents of 10 trace elements in the non-detrital fraction of limestones can be determined spectrographically down to values of the order of 0.05 ppm. For 5 other elements the method is useful but less sensitive. The method is based on the mixed precipitants technique of Mitchell and Scott (1947) and Heggen and Strock (1953) modified to satisfy the requirements of investigations in sedimentary geochemistry. --Auth.

1-162. Richardson, P.W., and H. E. Hawkes. ADSORPTION OF COPPER ON QUARTZ: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 6-9, fig., Nov. 1958.

Quantitative, colorimetric determinations were made of the amount of Cu adsorbed to the surface of fine-grained quartz particles from dilute, aqueous, Cu solutions of varying concentration and pH. It was found that the amount of adsorption varies roughly as the square root of the concentration of Cu ions in solution, within the pH range where Cu does not precipitate as hydroxide and where the adsorbing surface of the quartz has a net negative charge. --Auth.

1-163. Evans, H.T., Jr., and R. M. Garrels. THERMODYNAMIC EQUILIBRIA OF VANADIUM IN AQUEOUS SYSTEMS AS APPLIED TO THE INTERPRETATION OF THE COLORADO PLATEAU ORE DEPOSITS: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 131-49, 4 figs., Nov. 1958, 32 refs.

All available chemical and thermodynamic information is utilized to construct a diagram showing the stability relationships of the known V compounds in aqueous equilibrium in terms of oxidation potential and pH. The disparity between the observed precipitation conditions and those calculated from the published free energies of the oxides is used to estimate the free energy of hydration of the hydrated forms found in nature. The well-established V mineral species (not including silicates) are assigned regions of stability on the equilibrium diagram on the basis of chemical constitution, crystal structure and observed petrologic associations. It is found that a completely self-consistent alteration sequence appears on the mineral diagram, showing the changes that occur in the V ores under weathering conditions. Montroseite, VO(OH), is evidently the primary mineral source of V. Two distinct branches appear in the alteration sequence: one is confined to acid conditions characteristic of zones of primary vanadium oxide concentration in the sandstone in the presence of pyrite; and the other occurs in more basic conditions where calcite is common. The equilibrium diagram is used to draw tentative conclusions regarding the conditions under which the original montroseite was deposited in the sandstones, presumably through the action of mineralizing solutions. --Auth.

1-164. Garrels, R. M., and C. R. Naeser. EQUILIBRIUM DISTRIBUTION OF DISSOLVED SULPHUR SPECIES IN WATER AT 25°C AND 1 ATM TOTAL PRESSURE: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 113-30, 19 figs., Nov. 1958.

The E_h-pH diagrams for the equilibrium concentrations in aqueous solution at 25°C of native S and all the various S-containing ions and acids from which the ions are produced have been constructed for systems having a total S concentration of 0·1 molar. The composite of these diagrams indicates that elemental S, H_2S, HS^- HSO_4^- and $SO_4^{=}$ are the species that predominate in the environments that might be found in nature. This indication is in agreement with the composition of all S-containing minerals. --Auth.

1-165. Holser, William T., and George C. Kennedy. PROPERTIES OF WATER. PART IV. PRESSURE-VOLUME-TEMPERATURE RELATIONS OF WATER IN THE RANGE 100-400 C AND 100-1400 BARS: Am. Jour. Sci., v. 256, no. 10, p. 744-54, 2 figs., Dec. 1958. Also pub. as: Univ. of California (Los Angeles), Inst. Geophysics, Pub. no. 103.

New precision measurements of the specific volume of water in the range 100-400 C and 100-1400 bars are generally close to earlier published measurements. Recent measurements in the critical region by Kirillin, Rumiantsev, and Zubarev are used to complete a table of specific volumes for this range. --Auth.

1-166. Roy, Della M. STUDIES IN THE SYSTEM CaO-Al_2O_3-SiO_2-H_2O IV; PHASE EQUILIBRIA IN THE HIGH-LIME PORTION OF THE SYSTEM CaO-SiO_2-H_2O: Am. Mineralogist, v. 43, no. 11/12, p. 1009-1028, 3 figs., 5 tables, Nov.-Dec. 1958, 32 refs.

Phase equilibria in the high-temperature portion of the system CaO-SiO_2-H_2O were determined by the use of hydrothermal quenching techniques. Three previously unidentified phases, designated X, Y, and Z, having the probable compositions $8CaO \cdot 3SiO_2 \cdot 3H_2O$, $6CaO \cdot 3SiO_2 \cdot H_2O$ and $9CaO \cdot 6SiO_2 \cdot H_2O$ were found to be stable to temperatures above 800°C.

at moderate water pressures. X-ray diffraction patterns, optical properties, and infrared absorption spectra were obtained, and are diagnostic for the various phases.

The equilibrium temperature for the reaction $C_8S_3H_3$** = α'Ca_2SiO_4 (bredigite) + CaO + H_2O increases from 820° C. at 2000 psi to 870° C. at 15,000 psi. The curve for C_6S_3H = α'Ca_2SiO_4 + H_2O ranges from 790° C. at 7,500 psi to 810° C. at 15,000 psi; and the reaction C_9S_6H = rankinite +H_2O varies from 807° C. at 2000 psi to 820° C. at 15,000 psi. C_3SH_2 is in equilibrium with X($C_8S_3H_3$) + $Ca(OH)_2$ at 505° C. at 10,000 psi and 520° C. at 15,000 psi. Afwillite decomposes at about 215° C. at 15,000 psi.

X is apparently a calcium analogue of chondrodite (Taylor, personal communication), and a related phase X* formed from compositions near the C_2S ratio at low pressures may be another member of the chondrodite-type series. Attempts made to synthesize members of the chondrodite series in the MgO-SiO_2-H_2O system for comparison were largely unsuccessful. Possible applications of the results to the study of cement materials and mineral associations are discussed. --Auth.

1-167. Ehmann, W. D., and T. P. Kohman. COSMIC-RAY-INDUCED RADIOACTIVITIES IN METEORITES-I. CHEMICAL AND RADIOMETRIC PROCEDURES FOR ALUMINIUM, BERYLLIUM AND COBALT: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 340-63, 5 figs., Oct. 1958, approx. 65 refs.

It is expected that the long-lived radionuclides Al^{26}, Be^{10} and Fe^{60} (with its daughter Co^{60}), among others, are present in detectable amounts in meteorites as the result of the action of cosmic rays in space. For the detection and measurement of these activities, which have considerable potential significance, chemical isolation and purification are essential.

Chemical procedures developed for the separation and purification of aluminium, beryllium, iron and cobalt from iron and stone meteorites, tektites, and terrestrial silicate materials are described in detail. The prime objective was radiochemical purity of the isolated radioelements, chemical purity and chemical yields being of secondary importance. Ion-exchange and solvent-extraction techniques were used wherever possible because of their high specificity and applicability to very small quantities of elements.

Al^{26} and Be^{10} are prepared for counting in the forms of Al_2O_3 and BeO. Fe^{60} is best detected by extraction of its active daughter Co^{60}, counted as CoS. The identity of a radionuclide is established by the criterion of constant specific activity upon recycling the sample through the chemical purification procedure.

Special low-background counters have been constructed for the detection and measurement of feeble amounts of beta emitters in the form of small solid samples. The backgrounds are about 0·4 count min^{-1} and are exceptionally constant. In routine operation 3-4 day backgrounds are alternated with 6-8 day sample counts, yielding a lower counting rate limit (2 σ criterion) of 0·017 count min^{-1}. With counting yields of about 40% and specimen sizes of about 100 g, it is possible to detect radionuclides at a specific activity of 0·0004 dis min^{-1} (g specimen)$^{-1}$ in favourable cases.

Thin-sample counting yields have been measured for Al^{26} and Na^{22}. Sample-thickness factors have been determined for Al^{26} in Al_2O_3 and Be^{10} in BeO. --Auth.

1-168. Ehmann, W. D., and T. P. Kohman. COSMIC-RAY-INDUCED RADIOACTIVITIES IN METEORITES-II. Al^{26}, Be^{10}, and Co^{60}, AEROLITES, SIDERITES AND TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 364-79, Oct. 1958, 57 refs.

The long-lived radionuclides Al^{26} and Be^{10} and the 5 year Co^{60} have been detected in stone and iron meteorites. The highest levels observed, in disintegrations per minute per gram of specimen were: in stone, Al^{26}, 0·063; Be^{10}, 0·0051; Co^{60}, 0·0018; in iron, Al^{26}, 0·0055, Be^{10}, 0·00070; Co^{60}, 0·033. The Al^{26} and Be^{10} were evidently produced by cosmic-ray bombardment of the meteorites before fall. The Co^{60} seems to have been produced principally by neutron capture in ordinary cobalt in recent years while the specimens were on earth, although disintegration of the long-lived Fe^{60} may contribute some Co^{60}.

The Be^{10} : Al^{26} ratio is definitely lower in the Plainview chondrite than in the Richardton chondrite, suggesting that the former may have existed as a small body for only about a million years. The presence of both activities in the Odessa siderite indicates that it and its associated craters are probably less than about a million years old. The absence of these activities in the Canyon Diablo siderite is probably ascribable to a shielded position of the specimen inside the large meteoroid.

Al^{26} is definitely and Be^{10} fairly certainly present in australites, indicating that tektites are glass meteorites and have spent at least a million years or so in space. Both activities are also present in Libyan Desert silica-glass, indicating that it is a varity of tektite. From the Al^{26} and Be^{10} levels or limits, in comparison with the levels in chondrites, the following approximate terrestrial ages or limits, in millions of years, are calculated: australites, $<0\cdot5$; Libyan Desert silica-glass, $\sim 3\cdot5$; bediasites, $>1\cdot2$; moldavites, >3.

Measurements of these and other nuclides can give valuable information on the pre-fall and post-fall histories of meteorites and on the past intensity of the cosmic radiation. The average cosmic-ray flux over the past several million years appears not to have been grossly different from the present value. --Auth.

1-169. Cassidy, W. A. ACHONDRITE INVESTIGATIONS AND THEIR BEARING ON THE ORIGIN OF TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 304-15, 6 figs., Oct. 1958, approx. 35 refs.

A common origin for chondrites, achondrites, and tektites seems reasonable. A lunar impactite origin for tektites seems doubtful because their content of cosmic-ray-induced ^{26}Al and ^{10}Be indicates much longer times of travel as small bodies in space than is possible in passing from the moon to the earth. A planet with a chondritic centre, an achondritic subcrust, and a tektitic crust is suggested as a possible place of origin. At the time of its disruption, the outer portions of the planet must have been hot enough so that the tektitic crust was molten and the achondritic sublayer was semimolten. Achondrite compositions are examined from this viewpoint. With increasing SiO_2 the composition of the achondrite series varies as follows: FeO, CaO, and Al_2O_3 undergo fractionations of 20 : 1, 6 : 1 and 7 : 1, respectively, while MgO is enriched by a factor of 8. This variation could not have been produced by crystal fractionation in a basic magma, but might have been produced by partition of chemical components between the achondrite and tektite layers due to a condition of liquid immiscibility in such a basic magma. This variation could also have been produced by crystal fractionation in an extremely acidic magma, but the acidic magma itself would have had to have been produced by a segregation due to liquid immiscibility. Both methods of accounting for the observed compositional variations among achondrites would result in the formation of a siliceous phase similar in composition to tektites. --Auth.

1-170. Barnes, V. E. PROPERTIES OF TEKTITES PERTINENT TO THEIR ORIGIN: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 267-78, illus., Oct. 1958, 64 refs.

Theories of the origin of tektites are examined to see if they explain the following critical properties: chemical properties, lechatelierite particles, two periods of melting, flow structure, shapes and sizes, and distribution of age.

A volcanic origin either from the earth or the moon cannot explain the above properties: neither can an origin from lightning, or as impactites from the moon, or from collisions of asteroids with each other.

The impact theory of Urey can explain the tektites if the molten rock was thrown beyond the earth's atmosphere and was remelted upon its return. The absence of partially fused tektites is against such a hypothesis.

The formation of tektites by the destruction of a planet similar to the earth should not be overlooked. --Auth.

1-171. Cohen, A. J. THE ABSORPTION SPECTRA OF TEKTITES AND OTHER NATURAL GLASSES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 279-86, 5 figs., Oct. 1958.

The absorption spectra of individual tektites known as australite, bediasite, indochinite, javanite, moldavite, and philippinite are compared in the 3000-26,000 Å region with that of Aouelloul glass, Libyan Desert glass, americanites, obsidian, perlite and an industrial welding goggle glass. The most characteristic feature of the absorption spectra of all these glasses in the range studied is the ferrous band with maximum in the 1·1-1·2 μ wavelength region of the near-infra-red. The spectra of these materials were not affected by X-ray treatment with the exception of an obsidian which showed an increase in the ultra-violet cut-off and growth in the ferrous band. The refractive indices ($\underline{N_D}$) are compared and appear to be related to total iron content of the glass. --Auth.

1-172. Friedman, Irving. THE WATER, DEUTERIUM, GAS AND URANIUM CONTENT OF TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 316-22, 4 figs., Oct. 1958.

The water content, deuterium concentration of the water, total gas and uranium contents were determined on tektite samples and other glass samples from Texas, Australia, Philippine Islands, Java, French Indo-China, Czechoslovakia, Libyan Desert, Billiton Island, Thailand, French West Africa, Peru, and New Mexico. The water content ranges from 0.24% for the Peru tektite, to 0.0002% for a moldavite. The majority of the tektites have less than 0.05% water, and average 0.005% H_2O by weight. No other gases were detected, the lower detection limit being about 1 p.p.m. by weight. The deuterium content of the water in tektites is in the same range as that in terrestrial waters, and varies from 0.010 mole % to 0.0166% deuterium. The uranium content is about from 1 to 3 p.p.m.

The possible origin of tektites is discussed. The experimental data presented favour their being originally terrestrial, but produced by some catastrophic event. An extra-terrestrial source is not ruled out. --Auth.

1-173. Krinov, E. L. SOME CONSIDERATIONS ON TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 259-66, 2 figs., Oct. 1958, 30 refs.

Recent research on tektites in the Soviet Union has been devoted to studies of viscosities, major and minor element content, and ages by the potassium-argon method. The author reviews this work, and speculates on the probable origin of tektites. Spencer's impactite glass theory is favoured, as explaining the major surface features and composition of tektites. --Auth.

1-174. Pinson, W. H., Jr., L. F. Herzog, H. W. Fairbairn and R. F. Cormier. Sr/Rb AGE STUDY OF TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 331-39, fig., Oct. 1958. Also pub. as: Massachusetts Inst. Technology, MIT Age Studies, no. 2.

Eight tektite samples from 4 localities, Australia, Indo-China, the Philippines, and the Moldau Valley were analysed for Rb and Sr, and Sr isotopic composition analyses were made on 7 of the samples. Seven of the 8 samples are so similar in Rb/Sr ratios that a common source origin is postulated for the tektites. No radiogenic Sr^{87} was found in the tektites. All have normal 84/88, 86/88 and 87/86 ratios, namely, 0·0068, 0·1193, and 0·712. It is shown that the present Rb/Sr and Sr isotopic composition data is compatible (but unlikely) with an origin of tektites as differentiated from either proto-basaltic or achondritic material. The tektites could not have differentiated from chondritic material. Other than indicating a common and homogeneous source origin for the tektites, the present data are not evidence for or against an extra-terrestrial origin. However, the homogeneity in Rb/Sr contents and the constancy of the Sr^{87} contents make a terrestrial origin difficult to accept because of the wide geographical distributions of tektites. --Auth.

1-175. Rinehart, J. S. IMPACT EFFECTS AND TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 287-90, Oct. 1958.

Data on the composition, form and distribution of tektites are examined in the light of our knowledge of high speed impact phenomena to see how strong the evidence is for an impact origin. It is concluded that tektites could be of impact origin, but the arguments are inconclusive. A strong argument against such an origin, is the lack of nickel-ferrous materials within the tektite. --Auth.

1-176. Tilton, G. R. ISOTOPIC COMPOSITION OF LEAD FROM TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 323-30, Oct. 1958.

The isotopic composition of lead in 3 tektites and Libyan Desert glass is compared with that in known terrestrial and extra-terrestrial sources. The lead contained in the glasses is similar to modern terrestrial lead, particularly lead from modern oceanic sediments. The uranium, thorium and lead concentrations were determined for one of the glasses, an australite. Evidence is given which indicates that within the last tens of millions of years differentiation of uranium, thorium and lead occurred in the parent material of the australite. These results are difficult to explain in terms of any extra-terrestrial origin involving fusion of materials from the moon, meteorites or comets, but they are readily explained if tektites are of terrestrial origin involving fusion of argillaceous sediments in some unspecified way. --Auth.

1-177. Varsavsky, C. M. DYNAMICAL LIMITS ON A LUNAR ORIGIN FOR TEKTITES: Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 291-303, 5 figs. incl. maps, Oct. 1958.

Theories regarding the origin of tektites are reviewed, and it is proposed that the moon is the most likely source for these objects. Detailed calculations show that Whipple's model for the ejection of tektites from the moon makes it possible to reproduce their observed distribution over the earth's surface. --Auth.

1-178. Coulomb, R., M. Goldsztein, and M. Le Mercier. L'URANIUM DANS QUELQUES GRANITES FRANÇAIS [THE URANIUM IN SOME FRENCH GRANITES]: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 10-17, 4 figs., Nov. 1958.

The work which we present gives the laws of distribution statistics of uranium and of potassium in an important French granite massif. The systematic analyses permit us to distribute the two elements geographically and to establish the existence of correlations between the petrographic characteristics and the uranium content.

We study the statistical and geographical variations of uranium content, on the one hand as a function of the content of potassium in granites, on the other hand as a function of the presence of uranium-bearing layers. --Auth. (Transl.).

1-179. Chilingar, George V. SUMMARY OF "CHEMICAL COMPOSITION OF THE MAIN GENETIC TYPES OF CLAYS," BY. A. B. RONOV AND Z. V. KHLEBNIKOVA: Compass, v. 36, no. 1, p. 39-46, 7 figs., Nov. 1958. Original Russian paper pub. in Geokhimiya, no. 6, p. 449-69, 1957.

Composition was determined by Ronov and Khlebnikova on the basis of 10,500 chemical analyses of separate clay samples and 305 analyses of average assays from 7,932 spot samples. Although clay composition fluctuates considerably, the variations are quite regular and have rigid limits.

Low alumina content is characteristic of marine clays and continental clays in cold climates where source materials have not experienced intensive weathering. High alumina content characterizes clays of humid and hot regions. Composition of clays in cold climates approaches that of granodiorite. Only the geochemically most mobile elements (Na, Ca, Mg) have been partly removed. In humid and tropical regions, the intensive physical-chemical weathering also removes the more inert elements (Fe, K, Si), leaving the products of weathering enriched in the least mobile elements (Al, Ti, etc.). This process is the initial stage of bauxite formation.

Chemical composition of marine, lagoonal, and lacustrine clays of the arid zone is controlled by: 1) relatively weak weathering of the parent products, and 2) considerable introduction of Ca, Mg, Fe, and K from the sea water. --A. C. Sangree

1-180. Welby, Charles W. OCCURRENCE OF ALKALI METALS IN SOME GULF OF MEXICO SEDIMENTS: Jour. Sed. Petrology, v. 28, no. 4, p. 431-52, 6 figs., Dec. 1958.

The abundance of the alkali metals in 130 samples from the Gulf of Mexico was determined spectrographically. The results show that only a slight enrichment of Rb with respect to K exists in the sediments, while there is present a significant enrichment of Cs with respect to both K and Rb. The K-Na ratios indicate that these 2 elements are present in about the same proportions as in igneous rocks. The Li abundance is similar to that found in igneous rocks.

Thermal analyses suggest that Rb is enriched with respect to K in the illite-rich sediments and that these sediments are relatively low in Cs. That a relatively high Li content is associated with montmorillonite-rich sediments is also suggested.

The alkali metal content of the sediments apparently does not vary systematically with depth below the present sedimentary interface or with distance from shore. In the sediments from the eastern part of the Gulf the distribution of all the alkali metals is similar.

The results of the investigation suggest that much of the separation of the alkali metals and the enrichment of one with respect to another may occur during weathering and that the hydrated radii, and ionic potential based on the hydrated radii, are not the only factors which control the behavior of the alkali metals during the weathering and sedimentary cycles. --Auth.

1-181. Frondel, Clifford. GEOCHEMICAL SCAVENGING OF STRONTIUM: Science, v. 128, no. 3339, p. 1623-24, Dec. 26, 1958.

Crandallite, an abundant mineral belonging to the alunite structure type, is a geochemical host for ordinary Sr in the soil profile and the deeper ground-water circulation. It may be useful in the scavenging or storage of the radioisotopes of Sr and certain other elements. --Auth.

1-182. Miller, Donald S., and J. Laurence Kulp. ISOTOPIC STUDY OF SOME COLORADO PLATEAU ORES: Econ. Geology, v. 53, no. 8, p. 937-48, Dec. 1958.

A number of selected U ore specimens from several localities have been analyzed for U and Pb in both pitchblende and galena phases by isotope dilution techniques, and the Pb isotopic abundance determined. It is shown that the hypothesis of hydrothermal deposition of U accompanied by old radiogenic Pb from the basement at one time about 60 million years ago does not satisfy the isotopic data. A new hypothesis is presented which requires local sources with high U/Th and U/Pb ratios, variable Rn leakage, suitable ground-water movement, and deposition at the site of H_2S production at low temperature. This hypothesis can explain the age discordances and the Pb isotope abundances in galena. It is possible from the isotopic data to have all deposition occurring within the last 5 million years, but it does not preclude other periods of deposition such as in Laramide time. The isotopic ages are apparent ages only and bear no direct relation to the time of deposition. The isotopic ratios, however, provide information which may be used to restrict theories of origin. --Auth.

1-183. Sakai, H., and H. Nagasawa. FRACTIONATION OF SULPHUR ISOTOPES IN VOLCANIC GASES: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 32-39, 2 figs., Nov. 1958.

The $^{34}S/^{32}S$-ratios in several samples of SO_2 and H_2S from the fumaroles of Volcano Showa-shinzan, Japan, were measured. The outlet temperature of the fumaroles from which the samples were collected ranged from 100^{o} to $661^{o}C$. It was observed that the lower the outlet temperature of the fumarole, the higher the content of the heavy isotope in the SO_2. The isotopic ratio of H_2S was found, on the other hand, to be almost constant throughout the range of temperature given above. This isotopic fractionation between SO_2 and H_2S was ascribed to the reaction:

$$H_2S + 2H_2O \rightleftharpoons SO_2 + 3H_2$$

The temperatures estimated from the observed fractionation factors and the theoretical ones were in fairly good agreement with the observed outlet temperatures.

The isotopic ratio of both compounds can be reasonably explained by a simplified system containing only H_2S, H_2O, SO_2 and H_2. But, some difficulty arises when the chemical compositions of the actual fumaroles are taken into consideration. --Auth.

1-184. Sakai, H., and Kazuo Sato. ISOTOPIC COMPOSITION OF THE COMMON LEAD OF JAPAN: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 1-5, fig., Nov. 1958.

Lead tetramethyl was synthesized from lead iodide isolated from 14 galenas, 2 anglesites and 6 pyromorphites of Japan. The mass spectrometric analysis was carried out for the peaks of Pb and lead hydride ions. The isotopic compositions of leads from these minerals lie within a narrow range. The average values for galenas are 18·51 ± 0·05 for $^{206}Pb/^{204}Pb$, 15·60 ± 0·05 for $^{207}Pb/^{204}Pb$ and 38·76 ± 0·15 for $^{208}Pb/^{204}Pb$. For Pb of secondary minerals they are 18·52 ± 0·05, 15·62 ± 0·05 and 38·78 ± 0·15, respectively. No detectable difference was observed between the isotopic compositions of primary and secondary Pb ores.

The ratios, $^{238}U/^{204}Pb$ and $^{232}Th/^{238}U$, in the source magma are estimated from the Pb abundances. They are 9·10 ~ 10·0 and 3·81 ~ 4·00, respectively. --Auth.

1-185. Aldrich, L. T., G. W. Wetherill, G. L. Davis, and G. R. Tilton. RADIOACTIVE AGES OF MICAS FROM GRANITIC ROCKS BY Rb-Sr AND K-A METHODS: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1124-34, fig., Dec. 1958, 31 refs.

Analytical data and ages are given for K-A, Rb-Sr, U-Pb, and Th-Pb ages from a number of locations. Comparisons of the ages obtained indicate (a) that K-A and Rb-Sr ages of mica usually agree when modern laboratory determined values of the decay constants of K^{40} and Rb^{87} are used; (b) that the K-A and Rb-Sr ages of micas agree with the U-Pb ages of cogenetic uraninite, zircon, and monazite when the U-Pb ages are concordant; (c) that when the U-Pb ages of these uranium minerals are discordant, the mica ages agree best with the Pb^{207}-Pb^{206} age; (d) that the pattern of K-A and Rb-Sr ages of micas can be most simply explained by postulating the loss of variable but small amounts of Ar from the mineral. --Auth.

1-186. Rubinshteyn, M. M., I. G. Grigor'yev, O. Ya. Gel'man, A. L. Khutsaidze, and B. G. Chikvaidze. K METODIKE POLUCHENIYA MONOMINERAL'NYKH FRAKTSKIY DLYA OPREDELENIYA ABSOLUTNOGO VOZRASTA GORNYKH POROD ARGONOVYM METODOM [ON THE TECHNIQUE OF OBTAINING MONOMINERAL FRACTIONS FOR DETERMINING THE ABSOLUTE AGE OF ROCKS BY THE ARGON METHOD]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 95-100, 2 illus., 2 figs., 6 refs.

The Argon method of determining the absolute age of rocks is the most convenient for wide-scale use in geological research. Not all K-containing minerals can be used for this purpose. The best mineral is mica - especially muscovite, biotite and glauconite. For the purposes of obtaining monomineral fractions of these minerals in large quantities (necessary for mass age determination), the author constructed 2 separators of which descriptions are given. --LC

8. MINERALOGY AND CRYSTALLOGRAPHY

See also: Geochemistry 1-166.

1-187. Ross, Malcolm, and C. L. Christ. MINERALOGICAL APPLICATIONS OF ELECTRON DIFFRACTION. I. THEORY AND TECHNIQUES: Am. Mineralogist, v. 43, no. 11/12, p. 1157-78, 16 figs. incl. illus., 4 tables, Nov.-Dec. 1958.

The small wave lengths used in electron-diffraction experiments and the thinness of the crystals necessary for the transmission of the electron beam combine to require a somewhat different diffraction geometry for the interpretation of electron-diffraction patterns than is used in the interpretation of x-ray diffraction patterns. This geometry, based on the reciprocal lattice concept and geometrical construction of Ewald, needed for the interpretation of transmission electron-diffraction single-crystal patterns, is here reviewed.

Transmission electron-diffraction single-crystal patterns of 2 monoclinic substances, colemanite [$CaB_3O_4(OH)_3 \cdot H_2O$] and potassium chlorate ($KC1O_3$), are examined, and the theory necessary for their interpretation is given in detail. The study of these patterns furnishes a basis for the interpretation of single-crystal patterns of materials belonging to any crystal system. It is shown that useful unit cell data, accurate to a few tenths of a per cent, can be obtained from the patterns of colemanite and $KC1O_3$. A method of evaluating unit cell data from measurements of such single-crystal patterns is given.

The transmission electron-diffraction powder pattern obtained from an oriented aggregate of thin crystals gives the same unit cell data as is given by the electron-diffraction single-crystal pattern obtained from one crystal of the aggregate. A graphical method is given for precisely evaluating unit cell constants from measurements of such a powder pattern. --Auth.

1-188. Kamb, W. Barclay. ISOGYRES IN INTERFERENCE FIGURES: Am. Mineralogist, v. 43, no. 11/12, p. 1029-1067, 19 figs., 7 tables, Nov.-Dec. 1958.

The use of skiodromes in interpreting interference figures of crystal plates leads to both qualitative and quantitative errors, and should be abandoned. The theory of isogyre patterns is correctly developed by considering the effect on isogyre position of "rotation" of the polarization plane by the optical system. Although the amount of the rotation may be 10°-15°, its effect on isogyre position is found to be small because the effects of rotation above and below the crystal plate work in opposite directions. An analysis, based on this conclusion, of the uniaxial flash figure, acute and obtuse bisectrix figures, and optic normal figure leads to isogyre equations from which can be calculated the angle of rotation of the stage (from extinction) required to disperse the isogyres from the field. The formulas are simple and convenient, and are verified experimentally by comparison with values measured upon oriented thin sections. They provide a means of measuring 2V in Bxo figures and in Bxa figures of large 2V, and in particular a means of distinguishing between Bxa and Bxo figures. The corresponding formulas given by the skiodrome theory and the theory of Michel-Lévy are not satisfactory. An analysis of the optic axis figure reveals that 45° isogyre curves derived by Wright upon seemingly unsound assumptions are in fact surprisingly accurate. Replacements for the skiodromes currently in use are mentioned. --Auth.

1-189. Smith, J. R. THE OPTICAL PROPERTIES OF HEATED PLAGIOCLASES: Am. Mineralogist, v. 43, no. 11/12, p. 1179-94, 3 figs., 5 tables, Nov.-Dec. 1958.

The optical properties of 9 chemically-analyzed samples of natural plagioclases have been accurately determined before and after changing them to high-temperature modifications by heat treatment. The change in Nx accompanying the structural change is slight in the composition range An O to An 20 and negligible from An 20 to An 100. Ny and Nz change measurably in the composition range An O to An 20, but negligibly in the remainder of the composition range. Measurements of principal refractive indices can therefore give a reliable estimate of the composition of a plagioclase regardless of its structural state.

The changes in optic axial angle accompanying the structural changes are such that, given composition, measurements of optic axial angle serve to distinguish low-temperature and high-temperature plagioclases in the composition ranges An O to about An 40 and An 60 to about An 90. --Auth.

1-190. Kopp, Otto C., and Paul F. Kerr. DIFFERENTIAL THERMAL ANALYSIS OF PYRITE AND MARCASITE: Am. Mineralogist, v. 43, no. 11/12, p. 1079-1097, 6 figs., 11 tables, Nov.-Dec. 1958.

Pyrite and marcasite were investigated by differential thermal analysis using a modification of a technique described by Kopp and Kerr (1957). Distinctive curves were obtained for both species. The initial oxidation peak of pyrite occurs at about 538°C. for a 50 mg. sample (125-149 micron fraction). Under the same conditions the initial oxidation peak of marcasite is noted at about 460°C. The writers believe that the lower peak temperature reflects the relative instability of marcasite in contrast to pyrite.

The thermal reaction products at 1000°C. are hematite and sulfur dioxide for both pyrite and marcasite. During the analysis pyrrhotite and other iron oxides may form as intermediate products. These may include maghemite and magnetite. At the completion of the oxidation reactions an endothermic reaction marks the Curie point.

Peak temperatures of both pyrite and marcasite are lowered by a decrease in grain size. The initial oxidation peak of marcasite merges with an adjacent higher peak for samples consisting of grains finer than 74 microns, and only a inflection in the curve is noted.

Peak areas increase with increase in sample weight in a relatively uniform manner, and greater detail is obtained for samples weighing more than 30 milligrams. Minor reactions which occur with increasing sample weight may result from oxygen depletion of the sample atmosphere. The heat evolved from the same weight of several pyrite and marcasite samples is found to be essentially the same. --Auth.

1-191. Kullerud, G., and G. Donnay. NATURAL AND SYNTHETIC FERROSELITE; A ROENTGENOGRAPHIC MIMESIS OF RAMMELSBERGITE: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 73-79, fig., Nov. 1958.

Iron diselenide ($FeSe_2$) has been synthesized in sealed, evacuated silica-glass tubes at temperatures between 450° and 550°C. Its powder pattern is identical with that of ferroselite described by Buryanova and Komkov (1955). The first 15 lines of the pattern are indistinguishable from those of rammelsbergite ($NiAs_2$). Single crystals of ferroselite from Temple Mt., Utah, were studied on the precession camera. Their diffraction patterns are also deceivingly similar to those of rammelsbergite. --Auth.

1-192. Van Valkenburg, A., and G. F. Rynders. SYNTHETIC CUSPIDINE: Am. Mineralogist, v. 43, no. 11/12, p. 1195-1202, 3 figs. incl. illus., 3 tables, Nov.-Dec. 1958.

Cuspidine ($3CaO \cdot 2SiO_2 \cdot CaF_2$) can be synthesized hydrothermally, from crystallizing melts, and by solid state reactions. Efforts to substitute hydroxyl for fluoride ions in the cuspidine structure were not successful, and this suggested that custerite, $3CaO \cdot 2SiO_2 \cdot Ca(F, OH)_2$ may not exist as a mineral. Synthetic cuspidine is monoclinic, optically positive with indices of refraction of $\alpha = 1.591$, $\beta = 1.596$, and $\gamma = 1.602$ ($\pm .003$). The extinction angle measured from the c axis is 7°. The specific gravity was determined as 3.05. Cuspidine melts congruently at approximately 1410° C. at atmospheric pressure. On prolonged heating cuspidine alters to γ-$2CaO \cdot SiO_2$ with the escape of silicon tetrafluoride. Powder x-ray data, a differential thermal curve, and an infrared spectrogram are given. --Auth.

1-193. Fyfe, W. S. A FURTHER ATTEMPT TO DETERMINE THE VAPOR PRESSURE OF BRUCITE: Am. Jour. Sci., v. 256, no. 10, p. 729-32, 4 figs., Dec. 1958.

An attempt has been made to determine the equilibrium vapor pressure of brucite by studying pressure-volume relations at constant temperature. The results obtained agree closely with those found previously by Kennedy but differ from those found by Roy and Roy. No reasonable explanation of this difference is offered except by the general observation that quenching methods are fundamentally sound only when the quench preserves the phases present under the conditions of the experiment. --Auth.

1-194. Kouvo, Olavi, and Yrjö Vuorelainen. ESKOLAITE, A NEW CHROMIUM MINERAL: Am. Mineralogist, v. 43, no. 11/12, p. 1089-1106, 3 illus., 3 tables, Nov.-Dec. 1958.

A new mineral was discovered at the Outokumpu mine in Finland. Its formula is ($Cr_{1.90}$, $V_{0.09}$, $Fe_{0.01}$) O_3 from chemical analysis. X-ray studies of single crystals and powders, as well as optical examination in reflected light, show the mineral to be isostructural with Cr_2O_3, the crystal structure of which, determined by Zachariasen (1928), has type $D5_1$ and space group $R\bar{3}c$. The cell dimensions are not measurably affected by the substitution of Fe^{+++} and V^{+++} for Cr^{+++}. The habit ranges from long prismatic to platy.

The new mineral was found by Yrjö Vuorelainen, and it is named in honor of Professor Pentti Eskola of the University of Helsinki. --Auth.

1-195. Muessig, Siegfried. FIRST KNOWN OCCURRENCE OF INYOITE IN A PLAYA, AT LAGUNA SALINAS, PERU: Am. Mineralogist, v. 43, no. 11/12, p. 1144-47, illus., Nov.-Dec. 1958.

Inyoite ($Ca_2B_6O_{11} \cdot 13H_2O$) is here reported from near the surface of the borate playa, Laguna Salinas, Peru. The mineral occurs as crystal aggregates in a discontinuous bed up to 15 cm. thick beneath a ulexite-bearing bed near the edge of the playa. The inyoite is the first established occurrence of a calcium borate in a playa. The mineral is primary at this place and was probably formed at about the same time as the enclosing muds. --Auth.

1-196. Smith, George L., Hy Almond, and Dwight L. Sawyer. SASSOLITE FROM THE KRAMER BORATE DISTRICT, CALIFORNIA: Am. Mineralogist, v. 43, no. 11/12, p. 1068-1078, 3 figs. incl. maps, sec., 3 tables, Nov.-Dec. 1958.

Sassolite (H_3BO_3), previously unreported from the Kramer borate district, California, was found near the base of the borate-bearing shales underlying the ore body. Probertite, ulexite, colemanite, borax, and kernite, all found within the borate body, produce alkaline borate solutions (pH values of 8.3 to 9.2) when dissolved in water. Thus the presence of sassolite, which forms in an acidic environment, is distinctly anomalous.

Sodium, borate, and sulfate form the major portions of the water-soluble materials in the sassolite-bearing rocks; Ca and Fe form lesser concentrations. Efflorescences of copiapite, mirabilite, sassolite, ulexite, borax and a little calcite and halite confirm the presence of their constituents in the wall rocks. The phase relationships between Na_2SO_4-$Na_2B_4O_7$-H_3BO_3-H_2O thus approximate the limiting conditions under which the sassolite probably formed. It is concluded that after lithification, sulfuric acid was formed by oxidation of iron sulfides by ground water; this reacted with earlier formed borates to form acidic borate solutions, and from these sassolite was deposited at some temperature below about 35°.

The optical properties and x-ray patterns of sassolite and copiapite are given; an analysis of the copiapite shows it to contain Fe, sulfate, and minor Cu and phosphate. --Auth.

1-197. Murdoch, Joseph. PHOSPHATE MINERALS OF THE BORBOREMA PEGMATITES: II - BOQUEIRÃO: Am. Mineralogist, v. 43, no. 11/12, p. 1148-56, 2 maps, 3 tables, Nov.-Dec. 1958.

The "alto" Boqueirão is a typical pegmatite of the heterogeneous type, which carries some unusual minerals besides those of the normal beryl-tantalite assemblage. Among them are minor amounts of uraninite, altered in part to uranophane and other secondary compounds; native Bi. Lithiophilite and many secondary phosphates appear as usual in the general inner portion of the pegmatite near the quartz core. Among these phosphates appear a pink variscite (carrying minor Be); metastrengite as sometimes showy blue coatings of minute crystals; huréaulite and minor tavorite as coatings on fractures of lithiophilite; stewartite, massive or in rare crystals; mitridatite (a hydrous calcium iron phosphate), in deep red blades, or very fine-grained masses yellowish to greenish in color. A new mineral, chavesite is described. It is hydrous calcium manganese phosphate, occurring as thin platy crystals coating lithiophilite, and associated with huréaulite and tavorite. Triclinic, a_o 5.49 b_o 13.07, c_o 5.79; α $91^{\circ}18\ 1/2'$, β $108^{\circ}3'$, γ $99^{\circ}44'$. The powder pattern resembles that of monetite, with which it may be isostructural. The stronger powder lines have the following spacings and intensities: 3.35 Å-10, 3.023 Å-2, 2.945 Å-3, 2.74 Å-2. --Auth.

1-198. Gross, Eugene B., Alice S. Corey. Richard S. Mitchell, and Kurt Walenta. HEINRICHITE AND METAHEINRICHITE, HYDRATED BARIUM

URANYL ARSENATE MINERALS: Am. Mineralogist, v. 43, no. 11/12, p. 1134-43, 2 illus., map, 7 tables, Nov.-Dec. 1958.

Heinrichite, $Ba(UO_2)_2(AsO_4)_2 \cdot 10\text{-}12H_2O$, and metaheinrichite, $Ba(UO_2)_2(AsO_4)_2 \cdot 8H_2O$, occur as tabular, yellow to green, fluorescent, transparent to translucent crystals belonging in the tetragonal system. Optically the minerals are uniaxial (-), sometimes anomalously biaxial with 2V up to 20^o. The refractive indices of heinrichite are: $\omega = 1.605 \pm 0.002$ and $\epsilon = 1.573 \pm 0.002$. Those for metaheinrichite are: $\omega = 1.637 \pm 0.001$ (1.641 ± 0.002 for the mineral from the Black Forest, Germany) and $\epsilon = 1.609 \pm 0.002$. The calculated specific gravity of metaheinrichite is 4.09 and the measured specific gravity is 4.04. The space group of metaheinrichite is $P4_2$, $P4_2/m$, or $P4_222$; $a_o = 7.07$ Å, $c_o = 17.74$ Å, and $a_o:c_o = 1:2.509$, $Z = 2$.

The minerals have thus far been found near Lakeview, Oregon, and in the Black Forest of Germany. They are named for Professor E. William Heinrich, University of Michigan. --Auth.

1-199. DeVries, R. C., and Rustum Roy. THE INFLUENCE OF IONIC SUBSTITUTION ON THE STABILITY OF MICAS AND CHLORITES: Econ. Geology, v. 53, no. 8, p. 958-65, 3 figs., Dec. 1958.

The equilibrium stability temperatures of various micas were determined and compared at the same water pressure. Dioctahedral minerals are considerably less stable thermally than trioctahedral phases. Substitution in the octahedral layer of Ni^{2+} for Mg^{2+} makes very little difference, and Ga^{3+} for Al^{3+} in the tetrahedral position strongly lowers stability temperatures.

In the chlorites, Cr^{3+} will only enter the structure if balanced by an equal amount of aluminum; and a drastic reduction in stability maximum is caused by the substitution. In this structure also Ni^{2+} exchange for Mg^{2+} causes very little change in stability temperature. These data are discussed from a crystallochemical viewpoint. --Auth.

1-200. Bassett, William A. COPPER VERMICULITES FROM NORTHERN RHODESIA: Am. Mineralogist, v. 43, no. 11/12, p. 1112-33, 11 figs. incl. illus., 5 tables, Nov.-Dec. 1958.

Vermiculite has been identified as the chief Cu-bearing mineral in samples of micaceous material from the Cu belt of Northern Rhodesia. These samples range from 2% to 7% Cu which is carried in the exchange position of the vermiculite. For comparison, copper vermiculite was synthesized from magnesium vermiculite and from biotite by simple base exchange procedures. The resultant materials give x-ray diffraction patterns with intensities for the 7 Å, 4.7 Å, and 3.5 Å reflections greater than those of a magnesium vermiculite, indicating that Cu has entered the exchange position of the vermiculite lattice. The natural samples give x-ray diffraction patterns having a similar distribution of intensities. In some of the natural samples this intensity distribution must be attributed to the presence of chlorite but in others it is due to Cu in the exchange position. Vermiculite has been distinguished from chlorite on the basis of differential thermal analysis, direct weight measurements of H_2O loss on heating, continuous x-ray diffraction during heating on the thermal increment diffractometer, and by exchanging large univalent ions for small bivalent ions in the exchange position. Cu appears to be firmly fixed in the vermiculite lattice, and no simple base exchange procedure was found for its removal from either the natural or the synthetic material. --Auth.

1-201. Schaller, W. T., and Angelina C. Vlisidis. AJOITE, A NEW HYDROUS ALUMINUM COPPER SILICATE: Am. Mineralogist, v. 43, no. 11/12, p. 1107-1111, illus., 2 tables, Nov.-Dec. 1958.

Ajoite is a new bluish-green hydrous aluminum copper silicate from Ajo, Pima County, Arizona. It was collected by Harry Berman in 1941 and recognized by him at that time as probably a new mineral. Mostly massive, a few cavities contain platy crystals or laths elongated parallel to c and flattened parallel to {010}. It is biaxial positive with indices of refraction $\alpha = 1.565$, $\beta = 1.590$, $\gamma = 1.650$, $+2V = 68^o$, $X = b$, $Z \wedge c = 15^o$. The specific gravity is 2.96. The x-ray powder pattern could not be related to that of any other copper silicate. The strongest lines are: 12.4 (100), 3.34 (25), 6.19 (9), 4.12 (9), 3.09 (9). Examination with an x-ray diffractometer showed that neither medmontite nor any montmorillonite group mineral can be present. Chemical analysis yielded the formula $Al_2O_3 \cdot 6CuO \cdot 10SiO_2 \cdot 5\ 1/2H_2O$. Ajoite is not related to any of the several impure mixtures of copper silicates and aluminum minerals. --Auth.

1-202. Blackmon, Paul D. NEUTRALIZATION CURVES AND THE FORMULATION OF MONOVALENT CATION EXCHANGE PROPERTIES OF CLAY MINERALS: Am. Jour. Sci., v. 256, no. 10, p. 733-43, 9 figs., Dec. 1958.

Exchange constants derived from observed titration curves for 3 clay minerals (beidellite, "illite", and bentonite) were used to calculate new titration curves against potassium, ammonium, and sodium hydroxides. Assuming 2 exchange sites, C^- and E^-, in each clay, the observed titration curves indicate that hydrogen is more firmly bound to the E^- sites than to the C^- sites in the order bentonite > beidellite > "illite". The E^- site, or substrate, in the titration of an H^+ substituted clay, is the weaker acid, that is, it is occupied only after all C^- sites are occupied by other cations. Differences in bonding strength of the C^- sites for the several clays are very small.

The exchange constants indicate that potassium and ammonium react in a similar manner and replace hydrogen more easily than sodium replaces hydrogen. In addition, potassium, ammonium, or sodium will replace one another more readily than they will replace hydrogen in the clays. --Auth.

9. IGNEOUS AND METAMORPHIC PETROLOGY

1-203. Hooker, Marjorie. DATA ON ROCK ANALYSIS - IV. ICELANDIC PERIODICAL AND SERIAL LITERATURE. BIBLIOGRAPHY OF ROCK ANALYSES: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 30-31, Nov. 1958.

The first chemical analyses of Icelandic rocks to appear in print were those in a paper by R. Bunsen in 1851. Sixteen analyses were listed by H. S. Washington from the literature for the years 1884-1913(U.S.Geol. Survey, Prof. Paper 99, 1917). Since Washington's work, more than 100 analyses of Icelandic rocks have appeared in books and articles published in many countries. The first publication of a rock analysis in an Icelandic journal was in 1931. Since then a total of 23 original analyses has appeared.

Listed are 7 Icelandic periodicals and serials and 7 references containing the 23 analyses, with notes on rock type, and area. The most recent reference was published in 1955.

Pts. I-III of the Data of Rock Analyses series dealt with Africa and New Zealand. --A. C. Sangree.

1-204. Goldsmith, Richard. GRANOFELS, A NEW METAMORPHIC ROCK NAME: Jour. Geology, v. 67, no. 1, p. 107-108, Jan. 1959.

The term granofels is proposed for medium- to coarse-grained, granoblastic, metamorphic rocks without, or with only indistinct, foliation or lineation. Existing terms such as granulite, hornfels, leptite gneiss, and leptynite gneiss are unsatisfactory for such rocks. Granofels is primarily a field name on a par with such terms as gneiss, schist, and slate. Granofels is transitional with hornfels in grain size and with gneiss in structure. --Auth.

1-205. Winkler, Helmut G. F., and Hilmar von Platen. EXPERIMENTELLE GESTEINSMETAMORPHOSE-II. BILDUNG VON ANATEKTISCHEN GRANITISCHEN SCHMELZEN BEI DER METAMORPHOSE VON NaCl-FÜHRENDEN KALKFREIEN TONEN [EXPERIMENTAL ROCK METAMORPHISM-II. FORMATION OF ANATECTIC GRANITIC MELTS IN METAMORPHISM OF NaCl-BEARING NON-CALCAREOUS CLAYS (in German, with English abs.)]: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 91-112, 7 figs., Nov. 1958.

Illite - quartz clays to which NaCl was added (to allow for saline solutions in the rock pores) were hydrothermally and isochemically treated between 350° and 800°C under 2000 atm of H_2O pressure. The results are compared with the experimental metamorphism and ultrametamorphism of the NaCl-free clay.

Below 390°C no reactions take place, but at 390° illite + kaolinite + NaCl + H_2O + Ca give muscovite + chlorite + Ab-rich plagioclase + HCl + H_2O. The next reaction follows at about 550°C, giving rise to the mineral assemblage cordierite, biotite, muscovite, plagioclase and quartz; chlorite is now absent. At this temperature the amphibolite facies is reached and at 600°, 625° or 665° (depending on the Na content) the pyroxen-hornfels facies is entered with the assemblage alkalifeldspar, cordierite, biotite ± sillimanite-mullite, plagioclase and quartz; muscovite is now absent.

At 670° and 720°C, respectively, the cordierite-gneisses derived from the NaCl-containing clays give rise to anatectic melts of granitic composition and calc-alkaline character. Since these melts comprise up to two-thirds of the previous cordierite-gneisses they are believed to have a fundamental bearing on the genesis of granites. --Auth.

1-206. Sukheswala, Ratan N., and Arie Poldervaart. DECCAN BASALTS OF THE BOMBAY AREA, INDIA: Geol. Soc. America, Bull., v. 69, no. 12, p. 1475-94, 4 figs., geol. map, Dec. 1958.

The islands of Bombay, Salsette, and Trombay expose basalts and associated rocks belonging to the Upper Deccan group, probably of Tertiary age. The basalts dip 10°-20°W. throughout the area. Interbedded with the basalts are sediments, mainly of tuffaceous origin and in part deposited in fresh water, and relatively small extrusives and intrusives of highly mafic rocks (monchiquite, ankaramite, oceanite) and of felsic rocks (rhyodacites, rhyolites). Previous work in the area is summarized.

Petrographic descriptions of the prevailing rock types and 9 new chemical analyses are given. Sixty-four analyses of Deccan rocks taken from the literature are reviewed. Averages are calculated for the Deccan basalts and for the Upper and Lower Deccan groups. The analyses are plotted on 4 types of chemical diagrams. Like many basaltic rock suites, the Deccan province shows an initial stage of iron enrichment, followed by dominant alkali enrichment. The average Deccan basalt has somewhat more FeO and less Al_2O_3 and MgO than most tholeiitic basalts.

The absence or scarcity of pigeonite in Deccan basalts is attributed to the chemical characteristics of the magma and rapid cooling with incomplete crystallization of the basalts. The felsic rocks are believed to represent differentiates of the basaltic magma, produced by crystal fractionation and diffusion of volatiles. Magmatic differentiation was directed initially toward a rhyodacitic residuum and only in the final stages toward rhyolitic melts with more K_2O than Na_2O. --Auth.

1-207. Ringwood, A. E. THE CONSTITUTION OF THE MANTLE - II. FURTHER DATA ON THE OLIVINE-SPINEL TRANSITION: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 18-29, 2 figs., Nov. 1958.

Subsolidus phase equilibria were studied in the system Mg_2SiO_4-Mg_2GeO_4 at 660°C and 30,000 bars in a squeezer apparatus. From the compositions of co-existing phases, the free energy of transition of forsterite from the olivine to the spinel structure is calculated. This enables the total pressure needed to cause this transition in forsterite to be determined. It is found to be about 90,000 bars at 660°C. This result, combined with analogous data obtained in Pt. I makes it possible to construct a P-T curve defining the olivine - spinel transition in forsterite.

A similar study was made in the system Fe_2GeO_4-Fe_2SiO_4 at 700°C and 25,000 bars, and it was predicted that a spinel polymorph of fayalite should become stable around 50,000 bars at 700°C. The predicted polymorph was subsequently synthesized and its transition pressure determined as 38,000 bars at 600°C. The spinel has a lattice constant of 8·235 Å and is 12% denser than fayalite.

A thermodynamic study of the stability of

$MgSiO_3$ pyroxene in the mantle is made. It is concluded that it will break down into Mg_2SiO_4 spinel and coesite at a maximum pressure not much greater than that required to produce the olivine - spinel transition in forsterite.

The pressures and temperatures required to cause the olivine - spinel transition indicate that the transition will occur in the upper 1000 km of the mantle. Because of solid solution effects, the transition will occur over an appreciable depth range. --Auth.

1-208. Bonorino, Félix González. HYDROTHERMAL ALTERATION IN THE FRONT RANGE MINERAL BELT, COLORADO: Geol. Soc. America, Bull., v. 70, no. 1, p. 53-90, 16 figs., 2 pls., Jan. 1959.

Hydrothermal alteration associated with ore veins in a large part of the Front Range mineral belt was studied in an attempt to correlate it with the mineralogic, petrologic, and structural features of the ore deposits. Six patterns of alteration were found; they range from the simplest type with a single zone of hydromica to the most complex type with 5 zones that are characterized by phlogopite carbonate (fringe zone), montmorillonite, kaolinite, orthoclase, and hydromica (innermost zone). A regular mixed-layer illite-montmorillonite mineral may substitute for hydromica either in the whole or in the outer part of the innermost zone, thus producing 2 subpatterns. Phlogopite and siderite represent the alteration of biotite; they extend to and suddenly increase at the hydromica zone. The remaining zones are based on the alteration of plagioclase. Microcline and quartz are stable in all zones.

Generally, the simplest alteration patterns are found in the southwestern part and along the western side of the belt. They are closely related to Laramide stocks, and most of the associated mineralization is of lead and zinc sulfides. The most complex patterns predominate along the eastern side and are concentrated in the middle to northeastern part of the belt; they are associated preferably with tungsten, pyritic gold, and telluride gold deposits.

The origin of the complex patterns is explained in terms of chemical fronts developed as the altering fluids migrated away from the conduit. The altering fluids were probably gaseous and are believed to have been derived by fractional distillation from the main body of hydrothermal liquids. The remaining silica-rich, less volatile fraction filled the veins after wall-rock alteration. The fluids changed in composition through reaction with the wall rock and successively reached the stability fields of the various secondary minerals. The critical changes responsible for the front (and zone) formation are increase of Si/Al ratio, decrease of K concentration, and increase of pH. No evidence of mutual replacement among hydrothermal minerals was found. The amount of matter transferred during alteration was small. The formation of other patterns is explained on the same principles, assuming slightly different compositions of the altering fluids. An attempt is made to correlate the patterns of alteration with the distribution of the intrusive bodies. --Auth.

1-209. Borodin, L. S. O PROTSESSAKH NEFELINIZATSII I EGITINIZATSII PIROKSENITOV V SVYAZI S PROBLEMOY GENEZISA SHCHELOCHNYKH POROD IYOLITOVMEL'TEIGITOV [THE NEPHELINIZATION AND AEGIRINIZATION PROCESSES OF PYROXENITES IN CONNECTION WITH THE PROBLEMS OF THE GENESIS OF ALKALINE ROCKS OF THE IOLITE AND MELTEIGITE TYPES]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 48-57, 10 figs., 10 refs.

Structural correlation of nepheline and pyroxene in alkaline rocks of the iolite-melteigite type, and the peculiarities of their geological situation, indicate the metasomatic origin of nepheline. The author also comes to the conclusion that the formation of iolites and melteigites, which form together with pyroxenites the complex block of ultrabasic alkaline rocks, was brought about not by the intrusion of alkaline magma, but was a result of nephelinization and aegirinization of pyroxenites and other ultrabasic rocks. --LC

1-210. Kononova, V. A. O NEFELINIZATSII PIROKSENITOV I MRAMOROV [ON THE NEPHELINIZATION OF PYROXENITES AND MARBLES]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 58-68, 7 illus., 2 figs., 3 tables, 6 refs.

The author describes the formation of nepheline in pyroxenite and marble which she studied in the Balyktyg-Khem river region (SE. of Tannu Tuva). The formation of nepheline in pyroxenite (Dakhu-Nur intrusion) and in marble (Chik intrusion) are found exclusively in the zones of contact with the urtite-iolite intrusions, and could be regarded as an unusual contact phenomenon. The nephelinization of pyroxenite is accompanied by the development of characteristic poikiloblastic and corrosive textures - a result of a late appearance of nepheline which metasomatically replaced the pyroxenites. The nephelinized pyroxenite is heterogeneous in composition and has a "taxitic"[?] texture. In the Chik intrusion, rocks of the urtite-iolite group occur in marble and contain xenolites. The development of nepheline in marble is observed at points of contact with the intrusion. The xenolites are of different formations. In some places they are transformed into silica-carbonaceous rocks. The content of silicate minerals (nepheline, pyroxene and apatite) varies from 5 to 70%. Iolite-urtite rocks, especially near the point of contact with marble, are transformed into melteigites for a zone of about 15 cm. and contain 23% calcite. The nephelinization of pyroxenites described by the author is similar to the nephelinization observed in South Africa. --LC

1-211. Sutton, John, and Janet Watson. METAMORPHISM IN DEEP-SEATED ZONES OF TRANSCURRENT MOVEMENT AT KUNGWE BAY, TANGANYIKA TERRITORY: Jour. Geology, v. 67, no. 1, p. 1-13, 3 figs. incl. 2 sketch maps., pl., Jan. 1959.

Deformed rocks developed in zones where transcurrent movements took place during a late stage of the Ubendian orogeny are described from Kungwe Bay, western Tanganyika Territory. In areas where the regional metamorphism was still continuing, the mineral assemblages developed in the movement zones are the same as those developing regionally. Cataclastic textures characterize such movement zones. In other parts of the district, where the regional metamorphism had apparently come to an end, the zones of concentrated movement contain both mylonites and certain fine-grained deformed rocks which show no obvious cataclastic features. Some of the latter have textures recalling those of hornfelses and contain minerals such as garnet and hornblende which have remained stable during the deformation and have grown porphyroblastically. It is considered that these rocks result from deformation of the crust at depth, resulting in a local high-grade dislocation metamorphism to which heat released during the movements may have contributed. The significance of the deformed rocks and of the transcurrent movement system in which they occur is discussed, and a possible analogy with active seismic belts of the present day is mentioned. --Auth.

10. SEDIMENTARY PETROLOGY

See also: Geochemistry 1-179, 1-180.

1-212. Shepps, Vincent C. "SIZE FACTORS," A MEANS OF ANALYSIS OF DATA FROM TEXTURAL STUDIES OF TILL: Jour. Sed. Petrology, v. 28, no. 4, p. 482-85, 2 figs., Dec. 1958.

Tills on the Allegheny Plateau in northeastern Ohio and northwestern Pennsylvania can be differentiated on the basis of percentages of sand, silt, and clay. However, for comparing size analyses of tills from very large populations it is convenient to reduce each analysis to a single number. The median size is the most useful single number; however, it can be determined only from a detailed analysis, which is very time consuming. Plotting the percentage of sand and clay on a rectangular graph and dividing the area into numbered narrow "zones" provides a series of numbers called "size factors" which serve the same purpose as median diameters. An approximation to median size is obtained by reference to a chart. --Auth.

1-213. Weiss, Malcolm P. CORROSION ZONES: A MODIFIED HYPOTHESIS OF THEIR ORIGIN: Jour. Sed. Petrology, v. 28, no. 4, p. 486-89, Dec. 1958.

New evidence suggests that the formation of corrosion zones takes place by solution in the intertidal zone, and that they are genetically related to similar surfaces that have undergone abrasion. Abraded and corroded diastemic surfaces are viewed as the end-members of a continuous, intergrading series. --Auth.

1-214. Berry, William B. N. DEPOSITIONAL ENVIRONMENT OF THE ORDOVICIAN SUCCESSION IN THE MARATHON REGION, TEXAS: Jour. Sed. Petrology, v. 28, no. 4, p. 389-405, fig., 4 pls., Dec. 1958.

Graptolites occur primarily in limestones in the Ordovician succession in the Marathon region. Study of thin sections of these limestones reveals that most of them were lime muds; however, oölitic and bioclastic limestones also bear graptolites.

Integration of the thin section study of the several rock types occurring in the Ordovician sequence with analysis of the associated sedimentary features enables recognition of 4 major environments. During the Early Ordovician, mud was accumulating in the region. Local sectors of it were frequently exposed for brief periods; also, for a short time, small patch reefs flourished. In the early part of the Middle Ordovician, strong currents swept the area and calcium carbonate oölites and aggregates formed. Aligned biserial graptolites and the direction of dip of the cross-laminae indicate that the last current to pass over the region came from the SW. Then a tidal mud flat developed during the latter part of the Middle Ordovician. It was occasionally swept by currents bearing pelagic organisms. Aligned biserial graptolites again indicate that the direction from which the current came was SW. Finally, during latest Middle Ordovician and all of the Late Ordovician, the region was predominantly accumulating lime mud under reducing conditions. --Auth.

1-215. Hough, J. L. FRESH-WATER ENVIRONMENT OF DEPOSITION OF PRECAMBRIAN BANDED IRON FORMATIONS: Jour. Sed. Petrology, v. 28, no. 4, p. 414-30, 3 figs., Dec. 1958.

Deposition of the banded silica and iron formations, which are typical of the middle "Huronian" rocks of the Lake Superior district, can be accounted for as follows. The region was in a very mature stage of geomorphic development, and the climate of the region was sub-tropical to warm-temperate, with moderate to high rainfall. Iron and silica were the principal products of weathering, being derived alternately during the cooler and warmer parts of the year. The environment of deposition was a large fresh-water lake, low in nutrients and thus having a relatively low organic productivity, and it was of sufficient depth to permit development of density stratification of the water during the summer. The lower water layer, in summer, was isolated from the atmosphere and had a slightly reducing and acid condition; iron was kept in solution in a reduced state but silica was deposited. During the winter the entire column of water in the lake circulated and it was oxidizing and alkaline, causing precipitation of the iron. Any of the iron minerals common to the banded iron formations could be deposited in this environment, because the stability fields of these minerals include the ranges of Eh and pH which occur in this type of lake. --Auth.

1-216. Van Straaten, L. M. J. U., and Ph. H. Kuenen. TIDAL ACTION AS A CAUSE OF CLAY ACCUMULATION: Jour. Sed. Petrology, v. 28, no. 4, p. 406-413, 4 figs., Dec. 1958.

The tidal flats on the southeastern border of the North Sea are developed behind a chain of barrier islands. In this area the grain size of the sand decreases from the inlets towards the inner shores and the tidal watersheds behind the islands. Likewise the clay content increases, so that muddy sands and even sandy muds are formed. This condition is explained by the action of tidal currents combining with other, mainly biological, phenomena. Pellets and flakes are formed and these are carried inwards in consequence of the "settling lag effect" and the "scour lag effect." In estuaries and tidal lagoons similar conditions may be responsible for lateral changes in clay content. In ancient basins such lateral increase in fine-grained material may indicate approach to the mainland shore and increasing distance from passes between sandy barrier islands. This study is an elaboration of suggestions offered by Postma (1954). A more detailed account with extended bibliography and full acknowledgements has been given in an earlier paper (van Straaten and Kuenen, 1957). --Auth.

1-217. Conley, R. F., and W. M. Bundy. MECHANISM OF GYPSIFICATION: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 57-72, 9 figs., Nov. 1958.

Petrographic studies have shown that many gypsum deposits have been formed by the hydration of anhydrite, but the mechanism for hydration has not been fully explained. Gypsum has been produced experimentally by the agitation of anhydrite in pure water, a reaction that is accelerated by certain acids, bases, and salts, particularly alkali sulphates.

Phase investigations and reaction velocity studies indicate that accelerated hydration of anhydrite takes place through the medium of transient surface complexes in dilute solution. Concentrated solutions may precipitate double salts.

Contrary to recent hypotheses of gypsum dehydration by concentrated salt solutions, double salts and/or gypsum are stable phases below a temperature of 42°C. Above 42°C double salts may replace anhydrite as the stable phase. Gypsum, however, may remain a metastable phase indefinitely in its saturated solution below the hemihydrate transition temperature (98°C).

Experimental data indicate that precipitation of anhydrite from sea water is unlikely. --Auth.

1-218. Emigh, G. Donald. PETROGRAPHY, MINERALOGY AND ORIGIN OF PHOSPHATE PELLETS IN THE PHOSPHORIA FORMATION: Idaho Bur. Mines & Geology, Pamph. 114, 60 p., 12 illus., map, May 1958, 54 refs.

Specimens for chemical analysis and petrographic examination were collected from different sedimentary phosphate deposits in the United States. The formations covered include: the Permian formation of Montana, Idaho, Wyoming, and Utah; the Ordovician formation of middle Tennessee; the Pennsylvanian formation of northern Arkansas; and the nodular phosphates on the sea floor off the coast of California.

Petrographic examination reveals the phosphate to be similar in physical form and mineralogy in all the formations studied. Physically, the phosphate is present as rounded pellets of diverse origin. A classification of 6 pellet types is proposed - fossil, encased, nodule, oolite, multiple, and coprolite. Mineralogically, the pellets are microcrystalline aggregates of what appears to be the carbonate-fluorapatite mineral francolite.

It is proposed that the phosphate pellets are replaced calcium carbonate pellets. If this hypothesis is correct, phosphate can be formed under any marine conditions, but the reaction will proceed faster under certain favorable conditions. --K. M. Hollenbaugh

1-219. Swain, Frederick M. ORGANIC MATERIALS OF EARLY MIDDLE DEVONIAN, MT. UNION AREA, PENNSYLVANIA: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2858-91, 12 figs., Dec. 1958.

The name Newton Hamilton formation is here applied to the widespread shaly facies of the Onondaga group in central Pennsylvania. The formation is divisible into two members: the Hares Valley dark gray shale and limestone member, above, a new name; and the Beaverdam Run dark gray shale, below, a name modified from the usage of Willard.

The bituminous materials of the Devonian shales in the Mt. Union area range from .002 to .24% of the rock, with the Marcellus black shale containing the largest quantities. The bitumens, on separation by means of column chromatography, were found to contain fractions referable to saturated hydrocarbons, aromatic hydrocarbons, asphaltenes, and polar compounds.

Experiments with gas chromatography of the bituminous materials suggest that most of the column chromatographic fractions consist of compounds having carbon numbers above 20.

Upward from the Ridgeley sandstone to the Newton Hamilton, Marcellus, Mahantango, and Burket shales, the saturated hydrocarbons form an increasing percentage of the bitumens and of total hydrocarbons whereas the aromatic hydrocarbons decrease upward. This relation is believed to have a paleogeographic significance, resulting from the greater stagnation and poorer circulation of the Oriskany through Marcellus seas as compared with the Mahantango and Burket.

A resume is given of some of the relations of the bitumens to the petrologic-environmental types (*petrai*); the nearshore *petra* and depressional sapropelic *petra* are relatively more favorable for hydrocarbon preservation than some of the other types.

Free sulphur is found in many of the Newton Hamilton and Marcellus samples but is less common in the overlying Mahantango. The sulphur-bearing layers, also characterized by increased content of aromatic and tarry fractions, imply restricted poorly circulated seas under stillstand or regressive conditions during deposition of the Onondaga and Marcellus.

Separation of a humic acid constituent having absorptive peaks at 264-272 $m\mu$ was made by sulphuric acid hydrolysis and paper chromatography. This material, believed to be a pyridine compound, ranges from .04 to 2% of the Devonian rocks, with the greatest concentrations occurring in the Marcellus and Burket black shales. --Auth.

1-220. Bissell, Harold J., and George V. Chilingar. NOTES ON DIAGENETIC DOLOMITIZATION: Jour. Sed. Petrology, v. 28, no. 4, p. 490-97, 3 figs., Dec. 1958.

Replacement of carbonate ooze containing metastable aragonite and magnesian calcite by Mg-bearing solutions during diagenesis possibly occurs in various environments and under varying chemical conditions, but it is believed that secondary porosity developed in the calcite-dolomite replacement provides some of the avenues for ionic diffusion and for the escape of carbon dioxide. The intergranular film could play an important role in effecting transfer of Mg ions in, and Ca ions out, through the unstable crystalline water meshwork in this film during late diagenesis. --Auth.

1-221. Strakhov, N. M. FAKTY I GIPOTEZY V VOPROSE OB OBRAZOVANII DOLOMITOVYKH POROD [FACTS AND HYPOTHESES CONCERNING THE FORMATION OF DOLOMITIC ROCKS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 3-22, 9 figs., table, 9 refs.

The author reviews information collected during the last 10 years on the formation of dolomitic rocks. He distinguishes 2 petrographic types of rock: 1) stratified dolomite; 2) metasomatic dolomite. After carefully studying all available material, the author comes to the conclusion that there is no genetic difference between these 2 groups. In both cases the dolomite-forming material, containing Mg, was deposited from bottom water during some stage of sedimentary genesis. Details varied for both groups, but the main process was the same. Stratified dolomites in Paleozoic deposits represent the primary or sedimentary formations. The metasomatic dolomites are sedimentary diagenetic bodies, and dolomites which fill fissures, pores, or caverns are epigenetic minerals. Their different chemical composition is the result of changes in the surrounding atmosphere and water during different eras. --LC

1-222. Hay, Richard L. ORIGIN AND WEATHERING OF LATE PLEISTOCENE ASH DEPOSITS ON ST. VINCENT, B.W.I.: Jour. Geology, v. 67, no. 1, p. 63-85, 8 figs. incl. maps, 3 pls., Jan. 1959, 33 refs.

The island of St. Vincent consists of an active volcano and the remains of 2 or more that are extinct. Late Pleistocene subaerial ash deposits forming the uppermost geologic unit over much of the island are the object of the present study. Most of the deposits are between 20 and 40 ft. thick, but they reach a maximum thickness of at least 120 ft. They consist of andesitic lithic, crystal, and vitric material or their weathered equivalents. Plagioclase (An_{50-100}), hypersthene, augite, and olivine are the most abundant minerals.

The ash was erupted from the Soufrière. The pattern of grain size and thickness suggests that it was distributed by northwesterly Pleistocene winds quite different from those of the present. Four lithologic facies have been separated on the basis of sorting, grain size, and degree of weathering - namely, the Soufrière-slope, eastern-coastal, western-coastal, and upland facies. Differences between them can be explained by primary distribution of the ash and subsequent removal of the fine material on steeper slopes by sheet wash. The facies of ash therefore reflects the topography of the underlying land surface. Soils developed and were buried while the ash accumulated to form a sequence of fossil soils.

The vitric material and much of the plagioclase in the ash have been weathered to halloysite $\cdot 4H_2O$, and much olivine has been weathered to iddingsite. All the pyroxene and many of the olivine and plagioclase crystals have been etched by solution. Fine vitric ash was altered first, then plagioclase of composition An_{80-100}. Olivine of composition Fo_{74} was the first ferromagnesian mineral to alter and was followed by more magnesian olivine (Fo_{78-85}), hypersthene, and augite, all of which were destroyed at about the same rate. Hornblende weathered more slowly. Plagioclase phenocrysts in pumiceous fragments altered more rapidly than did discrete crystals of the same composition.

Minerals are more etched and otherwise altered in poorly drained clayey beds than in permeable beds, probably because the poorly drained beds provide a moist soil environment. Initial permeability differences in newly deposited ash seem adequate to account for differences in the degree to which the vitric ash has been altered to clay. --Auth.

1-223. Espenshade, Gilbert H. GEOLOGIC FEATURES OF AREAS OF ABNORMAL RADIOACTIVITY SOUTH OF OCALA, MARION COUNTY, FLORIDA: U. S. Geol. Survey, Bull. 1046-J, p. 205-19, pls. 12-15, Oct. 1958.

Areas of abnormal radioactivity S. of Ocala, discovered in 1953 by aerial survey, were investigated by surface examination and by 10 power-auger drill holes. Interbedded clay, clayey sand, and uraniferous phosphorite occur in the areas of anomalous radioactivity. Miocene fossils occur at 3 localities in these beds which are evidently outliers of Miocene sedimentary rocks on the Ocala limestone of Eocene age. The preserved outliers are SW. of the main belt of Miocene sedimentary rocks.

The principal uraniferous rocks are clayey, sandy, pellet phosphorite that occurs in beds a few feet thick, and very porous phosphatic sand rock that makes abundant float at many places. Apatite forms the phosphate pellets in the unweathered phosphorite. The very porous phosphatic sand rock is the highly leached residuum of the pellet phosphorite and is composed mainly of quartz, kaolinite, wavellite, and crandallite (pseudowavellite). It closely resembles the aluminum phosphate rock of the "leached zone" of the Bone Valley formation of Pliocene age in the land-pebble phosphate district. --Auth.

1-224. Wagner, W. R. EMMA MCKNIGHT NO. 1 WELL, PYMATUNING TOWNSHIP, MERCER COUNTY: Pennsylvania Geol. Survey, Well-Sample Rec. no. 40, 36 p., 1958.

This detailed description of samples has been divided into stratigraphic units. The units have been sub-divided into dominant lithologies, and thicknesses have been assigned to the units.

Cuttings collected by the driller were washed, placed on a watch glass, covered with water, and examined under a 10-X binocular microscope. Artificial light was filtered through a blue lens and focused on the sample so as to approximate sunlight. In order to be more objective in color description, the color chart prepared by the Rock-Color Chart Comm. (distributed by the Geological Society of America) was used. --Auth.

1-225. Wagner, W. R. GOODWILL-CURLEY NO. 1 WELL, SUMMIT TOWNSHIP, ERIE COUNTY: Pennsylvania Geol. Survey, Well-Sample Rec. no. 39, 48 p., 1958.

The description of samples is divided into 2 parts, a "skeletal log of the samples" and a "detailed sample description." The skeletal sample log has been divided into stratigraphic units. The units have been sub-divided into dominant lithologies, and thicknesses have been assigned to the units.

The "detailed description" consists of descriptions of each sample taken by the drillers. The samples were washed, placed on a watch glass, covered with water, and examined under a 10-X binocular microscope. Artificial light was filtered through a blue lens and focused on the sample so as to approximate sunlight. In order to be more objective in color description the color chart prepared by the Rock-Color Chart Comm. (distributed by the Geological Society of America) was used. --Auth.

11. GEOHYDROLOGY

See also: Geologic Maps 1-14; Areal and Regional Geology 1-55, 1-62, 1-63.

1-226. Kudelin, B. I. RAZVITIYE PREDSTAVLENIY I PONYATIY O RESURSAKH I ZAPASAKH PODZEMNYKH VOD ZA SOVETSKOYE VREMYA [DEVELOPMENT OF NOTIONS AND CONCEPTIONS ABOUT SUBSURFACE WATER RESOURCES DURING THE SOVIET REGIME]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 150-51, 1958.

Resume of lecture given Oct. 31, 1957. P.I. Butov and F. P. Savarenskiy were the first geologists to take up the question of classifying subsurface water resources during the 1930's. Later, numerous geologists, such as K. I. Makov, M.Ye. Altovskiy, Ye.F. Tamm, M.P.Tolstoy, N.A. Plotnikov, M.P.Semenov and others studied the problem of classifying subsurface water resources. The manual issued in 1952, "Instructions for Conducting Classifications of Available Subsurface Water Resources," set up a certain terminology for the specialized hydrogeological literature. In 1955, the author introduced the term "Flexible Resources of Artesian Strata" for the calculation of which the author developed a formula. The subsurface water resources can be subdivided in "natural" and "exploitable" categories. The theory of a flexible system of subsurface water resources should be further studied and developed. Also, the above-mentioned manual should be revised. --LC

1-227. Shchelkachev, V. N. SOVREMENNOYE SOSTOYANIYE TEORII UPRUGOGO REZHIMA VODONOSNYKH I NEFTENOSNYKH PLASTOV [THE PRESENT STATE OF THE THEORY OF FLEXIBILITY OF WATER AND OIL-BEARING STRATA]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 153-54, 1958.

Resume of lecture given March 20, 1958. The basic features of a flexible condition are: continuity at a redistribution of pressure, extraction of the flexible reserve liquids of the strata at lowered pressure. The author distinguishes 2 types of flexible conditions: flexible water pressure and locked flexible conditions. During the past 10 years, extensive research on the flexibility of blanket deposits of water and oil has been conducted in the USSR. Soviet scientists arrived at an empirical formula, which enables one to calculate the coefficient of volumetric flexibility of the water, when the gravimetric concentration of salt in the water and its relative specific weight under blanket deposit conditions is known. --LC

1-228. Ore, H. Thomas, and Edward D. White. AN EXPERIMENT IN THE QUANTITATIVE ANALYSIS OF DRAINAGE BASIN CHARACTERISTICS: Compass, v. 36, no. 1, p. 23-38, 4 figs., 2 maps, Nov. 1958.

The Laws of Stream Numbers and Stream Lengths, as proposed by Horton, are applied to two drainage basins within the same quadrangle, on the supposition that adjacent basins should be comparable quantitatively if the laws hold for any basin chosen at random. The geometric progression of stream numbers and lengths with increasing order are logical and valid laws, and from our method of defining order are to be expected. Measurements of areas and lengths were made by planimeter and map measure, both of which can yield data within the probable error of the topographic sheet. When plotted on semi-log paper, the geometric progressions of stream numbers and lengths are, in effect, converted to arithmetic progressions, and plot as straight lines. The logarithmic slope of these lines is here defined as that quantity which when multiplied by any term of the sequence gives the succeeding term. The information needed for analysis of a stream basin is practical to obtain and the analysis itself has definite functional possibilities. However, before drainage basin analysis can have any widespread use, a great amount of control information must be collected so that the theories can be tested over a wide range of conditions. --Auth.

1-229. Veviorovskaya, M. A. K VOPROSU O DRENIROVANII GRUNTOVYKH VOD RUSLAMI REK [THE QUESTION OF DRAINING SUBSURFACE WATERS THROUGH RIVER BEDS]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 154, 1958.

Resume of lecture given March 20, 1958. The interrelation between subsurface and surface waters is of importance in the calculation of the pressure of subsurface waters, the determination of underground discharge of rivers, water seepage through the banks of water reservoirs, and other water movements. The extent of subsurface water drainage by rivers, depends on a number of circumstances, among which are the width of the river, or the relation between the width of the river and the magnitude of the water-bearing level to be drained. --LC

1-230. Einstein, H. A., and Huon Li. SECONDARY CURRENTS IN STRAIGHT CHANNELS: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1085-88, fig., Dec. 1958.

The existence of straight uniform flows without secondary current is studied. It is shown that laminar flows of this kind can remain without secondary currents independent of cross section and velocity distribution. For turbulent flows it is shown that secondary flows will develop spontaneously if in any part of the section the expression for $\partial \xi / \partial t$ as given in Equation (19) is not vanishing. --Auth.

1-231. Brown, D. W. CHANGES IN THE CHLORIDE CONTENT OF GROUND-WATER IN PINELLAS COUNTY, FLORIDA, BETWEEN 1947 AND 1956: Florida Geol. Survey, Inf. Circ. no. 16,

11 p., 4 figs., Oct. 1958.

This report presents, in maps and tabular form, data on the chloride content of ground-water samples that were collected in 1947, 1948, 1951 and 1956. The maps show no definite pattern to the changes in chloride content between 1947 and 1956. A variety of varying conditions caused the irregular changes in chloride content between the sampling periods. --H.S.Puri

1-232. Kondratas, A. R. NOVYYE DANNYYE PO GIDROGEOLOGII MINERAL'NYKH VOD LITOVSKOY SSR [NEW DATA ON THE HYDROLOGY OF MINERAL WATERS OF THE LITHUANIAN S.S.R.]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 151-52, 1958.

Resume of lecture given Feb. 27, 1958. During recent years, numerous deep bore holes were drilled in the Lithuanian S.S.R., whereby layers of mineral waters of different chemical composition were found in the northeastern part of the Polish-Lithuanian artesian basin. It was established that the mineral content increased with greater depths. On the territory of the Lithuanian S.S.R., 2 districts of mineral waters can be distinguished; the northern and the southern. The author gives a description of the composition of the mineral water at different depths within these 2 districts. --LC

1-233. Ivanova, L.S. OPYT GIDROKHIMICHESKOY KHARAKTERISTIKI LANDSHAFTA VOLZHSKIKH ILMENEY [TESTING THE HYDROCHEMICAL CHARACTERISTICS OF "ILMENI" (INUNDATED AREAS) OF THE VOLGA REGION]: Moskov, Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 160, 1958.

Resume of lecture given Feb. 4, 1958. As a member of the Caspian Expedition of Moscow State University, the author conducted hydrochemical research on inundated areas along the Volga river. As a result of the research, the water of the "ilmen" was subdivided into 5 groups according to their salinity, and the ilmen proper into 3 groups according to the degree of salinity. Salinity tests are of importance for the future use of the ilmen, whether for water reservoirs or as irrigated farm land. --LC

1-234. Yartseva, Ye. N. RAYONIROVANIYE TERRITORII CHIZHINSKIKH RAZLIVOV I URALO-KUSHUMSKOGO MEZHDURECH'YA PO TIPAM GIDROKHIMICHESKOGO REZHIMA [DIVIDING THE CHIZHA FLOOD REGIONS AND THE URAL-KUSHUM INTER-RIVER AREAS INTO DISTRICTS ACCORDING TO TYPES OF HYDROCHEMICAL PROCESSES]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 152-53, 1958.

Resume of lecture given Feb. 27, 1958. The division into districts of decreasing-salinity, increasing-salinity and relative hydrochemical equilibrium, is accomplished by map analysis, schematic maps of the relief and surface drainage basins, maps of structure contour, and maps of subsurface water mineralization. The run-off conditions of the surface water influence the mineralization process of the subsurface waters: The author cites several instances of both increasing and decreasing salinity of subsurface water resources. --LC

1-235. Musgrove, R. H. FLOOD OF JUNE 9, 1957, AT PERRY, FLORIDA: Florida Geol. Survey, Inf. Circ. no. 17, 7 p., 8 figs., Nov. 1958.

This report presents data on a storm and flood that caused several million dollars damage in the local area. Data is presented on the rainfall accompanying the storm and peak flows of Spring and Pimple creeks.

It contains flood elevations at several points, and peak discharge of the 2 creeks flowing through Perry. The report contains a discussion of the rainfall associated with the features of the flood. --H.S.Puri

1-236. Miller, J. D., Jr. GROUND WATER IN THE VICINITY OF BRYCE STATE HOSPITAL, TUSCALOOSA COUNTY, ALABAMA: Alabama, Geol. Survey, Inf. Ser. 12, 31 p., 15 diags., 1958.

In the central and southern parts of the Bryce State Hospital area, conditions are favorable for the development of water supplies from the Coker formation. The basal sand is areally extensive and is fairly uniform lithologically, and its water-bearing properties are more predictable than those of the underlying Pottsville formation. It is probable that wells yielding 50 to 75 gpm. (gallons per minute) can be developed in the Coker where conditions are most favorable.

The report contains information on 15 test wells drilled as a part of the investigation. Four were drilled to the Pottsville formation, 3 of which were drilled to determine the feasibility of developing a water supply from 2 abandoned coal mines believed to be interconnected underlying the Bryce State Hospital area. Two of the wells penetrated the mines and yielded 270 gpm. each in short pumping tests. Data from these tests indicate, however, that the flow from the Pottsville formation to the abandoned mines is slow. A test well to explore the Pottsville formation was also drilled at the Bryce State Hospital's Graystone Farm, and it is estimated that this well will yield about 100 gpm. The Pottsville formation is more favorable than the Coker formation for the development of ground-water supplies in the northwestern, northern, and northeastern parts of the area because in many places the Coker is absent or is very thin. Owing to the nature of the occurrence of water at Pottsville formation, test drilling and test pumping are necessary preliminaries to the development of the ground-water supplies. The Pottsville and Coker formations contain water of good chemical quality in the area of Bryce State Hospital. --Auth.

1-237. Sanford, Thomas H., Jr. INTERIM REPORT ON GROUND-WATER STUDIES IN THE HUNTSVILLE AREA, ALABAMA, TO FEBRUARY, 1957: Alabama, Geol. Survey, Inf. Ser. 9, 131 p., 7 maps (in pocket), 1957 (released Sept. 1958).

The Huntsville area in S. - central Madison County comprises about 168 sq. mi. The area is underlain by massive beds of limestone of Mississippian age that dip gently to the SE. Ground water occurs in extensive joint, bedding-plane, and fracture systems in the limestone. Occurrence of these openings is related to geologic structure and soil thickness. Large additional ground-water supplies can be developed in the Huntsville area.

The water is soft to hard, moderately low in dissolved solids and low in sulphate and chloride. --Auth.

Maps (scale 1.3 in. to 1 mi.) include: structure map of Huntsville area, showing top of Chattanooga shale; soil isopach map; four piezometric maps.

1-238. Davis, Stanley N., and Francis R. Hall. **WATER QUALITY OF EASTERN STANISLAUS AND NORTHERN MERCED COUNTIES, CALIFORNIA:** Stanford Univ., Pubs., Geol. Sci., v. 6, no. 1, 114 p., 17 figs., 5 pls., Feb. 1959.

This report describes the geology and chemical quality of ground water in eastern Stanislaus and northern Merced counties. The oldest rocks exposed in the area are a complex assemblage of low-grade metamorphic rocks of Jurassic age with associated granitic intrusives. Cretaceous sandstone and shale, which underlie most of the area but do not crop out, reach a maximum thickness of more than 9,500 ft. Cenozoic formations that are exposed in the area include (1) the Ione formation, which consists of sands, clays, and gravels of Eocene age, (2) the Valley Springs formation, a sequence of clays, sands, gravels, and rhyolitic ashes of Miocene age; (3) the Mehrten formation, which is composed of andesitic silts, sands, and gravels of Miocene and Pliocene age, (4) the Turlock Lake formation, which consists of silts, sands, and gravels derived from granitic rocks in the Sierra Nevada during Late Pliocene and Early Pleistocene time, (5) the Riverbank formation, which is composed of clays, silts, and sands deposited during Middle Pleistocene time, and (6) the Modesto formation, which consists of silt and sand derived from Sierran granitic rocks during Late Pleistocene time. The Turlock Lake, Riverbank, and Modesto formations are defined for the first time in this report. Sand dunes and thin deposits of Recent alluvium overlie parts of the Modesto and older formations.

Methods of making chemical analyses of water were chosen on the basis of ease and rapidity. Most constituents were determined with an accuracy of about 2 ppm. A rough check of the accuracy of the analyses was made by measuring the electrical conductivity of the samples. Measurements of water temperature and pH were made in the field.

Irrigation water diverted from the Stanislaus, Tuolumne, and Merced rivers is a sodium-calcium-bicarbonate water with a total concentration of dissolved solids of less than 50 ppm. Water from wells less than 150 ft. deep is most commonly a sodium-calcium-bicarbonate water of less than 500 ppm total dissolved solids. Water from this depth range in Modesto and near the San Joaquin River is a sodium-calcium-bicarbonate-chloride water commonly containing more than 1,000 ppm total dissolved solids. Deeper wells W. of U.S. Highway 99 and along the Tuolumne River yield a sodium-calcium-chloride water which has a concentration of dissolved solids of more than 2,000 ppm. Discharge from some of these wells into the Tuolumne River increases the average summer chloride content of the river water at Modesto to about 180 ppm. In the rest of the area, water from deeper wells is similar to water from shallow wells.

Dissolved material is contributed to the ground-water basin from (1) imported irrigation water, (2) rain water, (3) connate water, and (4) soluble products of rock weathering. The local concentration of various ions is also affected by ion exchange and evaporation. The area of high chloride ground water along the Tuolumne River and in Modesto is best explained by migration of connate water from deeply buried marine sediments. Some chloride in Modesto may also be contributed by Tuolumne River water that recharges the aquifers during the summer. The high chloride water in shallow aquifers near the San Joaquin River is probably produced by the concentration of the chloride through evaporation of ground water and rain water. --Auth.

(May be published from: Publications Committee, Geology Dept., Stanford University, Stanford, Calif. Price: $2.00)

1-239. Isherwood, J. D., and A. F. Pillsbury. **SHALLOW GROUND WATER AND TILE DRAINAGE IN THE OXNARD PLAIN:** Am. Geophys. Union, Trans., v. 39, no. 6, p. 1101-1110, 9 figs. incl. 3 maps, Dec. 1958.

A study of the hydrology of the shallow ground waters of the Oxnard Plain, Ventura County, California, was made using a network of piezometers at 10 and 20 ft. below the surface. Mean depth to water is 6.8 ft. and shows little difference between Jan. and June readings during the years 1953-1956. The perched water table slopes to the S. and SW. It is only slightly above sea level near the coast. Piezometric head differences established the presence of a downward gradient over most of the area. The shape and rate of recession of the water table in tile-drained land and tile effluent rate were measured at various sites. Twenty-two per cent of water applied is discharged from tile lines as waste. Equipment and technique for hydraulic conductivity measurement in unstable soils is described. --Auth.

1-240. Bermes, Boris J. **INTERIM REPORT ON GEOLOGY AND GROUND-WATER RESOURCES OF INDIAN RIVER COUNTY, FLORIDA:** Florida Geol. Survey, Inf. Circ. no. 18, 74 p., 12 figs., Jan. 1959.

The most important source of ground water in Indian River County is the Floridan aquifer, which in the county consists of more than 500 ft. of limestone of Eocene to Miocene age. The Floridan is the principal artesian aquifer in most of Florida and southeastern Georgia. Rocks of Eocene and Oligocene age contribute most of the water to the flowing artesian wells penetrating the aquifer in the county, but limestone in the lower part of the Hawthorn formation, of Miocene age, supplies a small amount of water and is included in the Floridan aquifer. Pumping-test data show that the ground-water yield from the Floridan aquifer differs from place to place. Generally, where the aquifer produces less water (notably in the southern part of the barrier beach) it includes an appreciable thickness of Oligocene strata, which are less permeable than the Eocene strata.

Water levels in wells penetrating the Floridan aquifer fluctuate principally in response to the starting and stopping of discharge from the many irrigation wells during periods of heavy withdrawal. A cone of depression usually develops SW. of the vicinity of Vero Beach, and there is a general lowering of the piezometric surface in the northern part of the barrier beach. The static water levels in wells in some areas suggest an apparent decline in the piezometric surface of about 10 ft. since 1934.

No clear evidence of encroachment of sea water into the aquifer has been found. The chloride concentration in the water from some wells has increased substantially, but this is believed to be the result of a mixing of highly mineralized connate water that has never been flushed from the deep parts of the aquifer.

The nonartesian aquifer, of Pleistocene age, yields water of considerably better chemical quality than that from the Floridan aquifer. The City of Vero Beach obtains its water supply from a locally artesian zone in this aquifer. The use of the nonartesian aquifer will increase if the water from the Floridan aquifer becomes highly mineralized.

Appreciable quantities of water are obtained from the nonartesian aquifer only in the eastern part of Indian River County and on the barrier beach. In the southern part of the barrier beach the chloride content of the nonartesian water increases and the iron content is relatively high.

A separate artesian aquifer of relatively minor importance, consisting of beds of limestone in the middle and upper parts of the Hawthorn formation, underlies the western half of the county. The water from this aquifer is less highly mineralized than the water from the Floridan aquifer, but the yield from it is considerably less than that from the Floridan aquifer. --Auth.

1-241. Bermes, Boris J. INTERIM REPORT ON THE GROUND-WATER RESOURCES OF FLAGLER COUNTY, FLORIDA: Florida Geol. Survey, Inf. Circ. no. 13, 32 p., 11 figs., Oct. 1958.

Flagler County is in the northeastern part of the Florida Peninsula. The surface of the county is underlain by deposits of sand, marl, shell, and clay to depths ranging from 50 to 150 ft. Beds of coquina and sand in the upper part of these deposits were mapped by Cooke as the Anastasia formation and terrace deposits of Pleistocene age. They yield small quantities of nonartesian water of generally low mineral content to shallow screened wells. Beds of marl and phosphatic sand and clay in the lower part of these deposits are believed to be of Miocene or Pliocene age.

The deposits of sand, shell, and clay are unconformably underlain by limestone of Eocene age which yields large quantities of artesian water in which the mineralization ranges widely but is generally higher than that of the nonartesian water. The water in the limestone will flow at the surface in the lowlands along the western and eastern edges of the county. The artesian aquifer is recharged within the county and also in adjacent Volusia and Putnam counties.

Records of rainfall and fluctuations of artesian pressure show that in recent years the rainfall was deficient in the western part of the county, and that the artesian pressure head underwent a progressive decline of 3 ft. at Bunnell. Records also show that during this investigation the seasonal decline of pressure head due to pumping for irrigation was about 12 ft. in a well W. of Bunnell and about 5 ft. in a well near Codys Corner.

The chloride content of water from artesian wells ranges from less than 100 ppm. in the recharge areas near the towns of Espanola and Favorita to more than 2,000 ppm. in areas in the northeastern part of the county and SW. of Bunnell. The chloride content of the artesian water from some wells in certain farm areas increased considerably during periods of heavy pumping. --H. S. Puri

1-242. Leve, Gilbert W. INTERIM REPORT ON THE GROUND-WATER RESOURCES OF PUTNAM COUNTY, FLORIDA: Florida Geol. Survey, Inf. Circ. no. 15, 33 p., 11 figs., Oct. 1958.

Putnam County, in the northeastern part of the Florida Peninsula, has an area of 803 sq. mi. Sand, clay, and peat of Pleistocene and Recent age are exposed at the surface. They are underlain by deposits of Miocene or Pliocene age that consist principally of clay with a thin, fairly widespread limestone at the base. The Miocene or Pliocene deposits are underlain by limestones of Eocene age whose upper surface ranges from about 25 ft. to about 170 ft. below sea level.

Pleistocene and Recent sands contain water under nonartesian (water-table) conditions. The limestones underlying the Miocene or Pliocene clay contain water under artesian conditions, and locally the water in beds of sand and shell within the Miocene or Pliocene deposits is artesian. The artesian aquifers are replenished by rain falling on recharge areas partly or completely within the county.

Records of water level show maximum seasonal fluctuations of 10 ft. and a progressive decline of artesian head in recent years. The most pronounced seasonal fluctuation is in the winter vegetable farming area, east of Palatka, where discharge from irrigation wells lowers the artesian head and reduces the area of artesian flow during times of heaviest withdrawals.

The chloride content of water from wells in the principal artesian aquifer ranges from less than 2 ppm. to 1,080 ppm. Water of the lowest chloride content is in and near recharge areas in the upper part of the aquifer; water of the highest chloride content is in discharge areas, where the artesian head is lowest. In areas of seasonal discharge, the chloride content increases when the artesian head declines and decreases when it recovers. --H. S. Puri

1-243. Tarver, George R. INTERIM REPORT ON THE GROUND-WATER RESOURCES OF ST. JOHNS COUNTY, FLORIDA: Florida Geol. Survey, Inf. Circ. no. 14, 36 p., 13 figs., Oct. 1958.

St. Johns County is on the eastern seaboard in the northern part of the Florida Peninsula. Beds of sand, clay, marl, shell, and sandy limestone, of Pliocene, Pleistocene and Recent age, are exposed at the surface over all the county. They range from 25 to 140 ft. in total thickness and are underlain by relatively impervious beds of clay, sand, and limestone of Miocene or Pliocene age that range in thickness from 50 to 220 ft. A series of limestone beds several thousand feet thick underlies the Miocene or Pliocene clay. The uppermost unit of this limestone series is the Ocala group.

Measurements of artesian pressure head show that the piezometric surface fluctuates through a range of about 5 ft. each year in most of the county, being high in the winter and low in the summer. Withdrawal of large quantities of water for irrigation in southwestern St. Johns County during the potato-growing season of 1956 depressed the piezometric surface about 20 ft. below the winter high. A study of old water-level records indicates that there has been a decline of about 5 ft. in the piezometric surface in most of the county in the past 16 years and a much greater decline in the farming area.

The chloride content of water from the principal artesian aquifer in St. Johns County ranges from less than 10 ppm. in the northern section where the piezometric surface is relatively high, to more than 7,000 ppm. near Crescent Beach where the piezometric surface is relatively low. Deep wells in the farming area produce water having a chloride content as high as 2,500 ppm., whereas shallow wells in the same area produce less saline water, indicating that the chloride content of the water increases with depth. --H.S.Puri

1-244. Carlston, Charles W. GROUND-WATER RESOURCES OF MONONGALIA COUNTY, WEST VIRGINIA: West Virginia Geol. & Econ. Survey, Bull. no. 15, 64 p., 8 figs., 2 pls., 1958.

This bulletin describes the availability of ground water in Monongalia County. The relations of climate, topography, geology, and general hydrology to the occurrences of ground water are discussed; chemical character of the ground water is described. --Auth.

1-245. Nace, R. L., and P. P. Bieber. GROUND-WATER RESOURCES OF HARRISON COUNTY, WEST VIRGINIA: West Virginia Geol. & Econ. Survey, Bull. no. 14, 55 p., 2 maps, June 1958.

A short discussion of topography and climate is followed by descriptions of the various municipal water-supply systems in the county, including those of Bridgeport, Clarksburg, Lumberport, Salem, and Shinnston. Sources and quality of ground water are discussed, and it is concluded that available amounts of good water, in addition to those now in use, are not large. --Auth.

12. MINERAL DEPOSITS

See also: Geologic Maps 1-53; Areal and Regional Geology 1-58; Structural Geology 1-68; Geophysics 1-149, 1-151; Geochemistry 1-182; Sedimentary Petrology 1-223; Miscellaneous 1-281.

1-246. Fix, Carolyn E. SELECTED ANNOTATED BIBLIOGRAPHY OF THE GEOLOGY AND OCCURRENCE OF URANIUM-BEARING MARINE BLACK SHALES IN THE UNITED STATES: U.S. Geol. Survey, Bull., 1059-F, p. 263-325, pl., map, Nov. 1958.

This bibliography consists of 81 annotated references concerned with the geology and occurrence of U in marine black shales. The annotations, arranged alphabetically by author, present information on geology, geographic distribution, environment of deposition, mode of occurrence, and analytical data. A map shows the distribution and U content of uraniferous shales in the United States, including Alaska.

The data in the annotations are indexed according to author, geographic area, stratigraphic units, and subject. --Auth.

Includes map of occurrences of uranium-bearing black shales in the United States.

1-247. Miesch, Alfred T., and Thomas B. Nolan. GEOCHEMICAL PROSPECTING STUDIES IN THE BULLWHACKER MINE AREA, EUREKA DISTRICT, NEVADA: U.S. Geol. Survey, Bull. 1000-H, p. 397-408, figs. 33-37, Nov. 1958.

Investigation of the distribution of Pb, Zn, and As in soils of the Bullwhacker mine area, Eureka district, Nev., indicates dispersion patterns of these 3 metals in residual soils over near-surface ore at the Bullwhacker mine. Ore at greater depth in the shaft of the T.L. mine, however, is not reflected in Pb, Zn, and As contents of the soils.

The dispersion patterns are secondary residual soil anomalies in the classification given by H.E. Hawkes. --Auth.

1-248. Warren, Harry V., and Robert E. Delavault. RUBEANIC ACID FIELD TEST FOR COPPER IN SOILS AND SEDIMENTS: Mining Engineering, v. 10, no. 11, p. 1186-88, illus., Nov. 1958; also pub. in AIME Trans., v. 211, 1958.

Soil testing is now a recognized prospecting tool. Normal soils usually contain 10 to 50 parts of Cu in every million parts of soil. However, only 0.2 to 5% of this Cu can be found by any simple cold chemical attack. Nevertheless, rubeanic acid makes it possible for a prospector, or field geologist, readily to detect as little as 4 ppm of available Cu in a soil. This degree of sensitivity is adequate for determining the presence of Cu anomalous areas and eventually discovering buried Cu mineralization. --Auth.

1-249. Kelly, William C. TOPICAL STUDY OF LEAD-ZINC GOSSANS: New Mexico Bur. Mines & Mineral Resources, Bull. 46, 77 p., 12 figs., 7 pls., 1958, approx. 70 refs.

Several approaches to the problems of interpreting gossans developed from Pb-Zn ores were investigated.

X-ray studies and differential thermal analyses indicate that goethite is the dominant ferric oxide monohydrate in these gossans. Thermal analyses of gossan "limonites" show that this technique is not a reliable means of identifying the hydrous ferric oxide minerals.

Boxwork structures are reviewed. "Nonsulfide" boxworks observed in the field are at places sufficently similar to sulfide derivatives to cause some confusion regarding the nature of the original materials. "Boxwork siderites" may be hypogene or supergene. Supergene boxworks occur beneath oxidizing ore; hypogene boxworks do not bear as definite a spatial relation to ore.

Eh-pH diagrams for the system $Fe-H_2O-CO_2-S$ support the tentative conclusion that siderite precipitates in saturated ground and limonite in aerated ground. The formation of siderite is favored by presence of cuprous ion.

The quantitative relations between gossan porosity and the volume of leached sulfide is applicable only when voids after sulfides can be clearly distinguished.

Outcrop colors of Fe precipitates in leached Pb-Zn deposits are of local value as criteria of specific primary sulfides. However, no one gossan color or pattern was noted as universally diagnostic of the former presence of pyrite, galena, or sphalerite. --Auth.

1-250. Lapham, Davis M. PRELIMINARY REPORT ON THE CHROMITE OCCURRENCE AT THE WOOD MINE, PENNSYLVANIA: Pennsylvania Geol. Survey, Prog. Rept. 153, 11 p., 2 pls. (photomicrographs), 1958.

An almost completely serpentinized harzburgite concordant with a local chlorite - muscovite schist is present in the vicinity of the Wood chromite mine, Lancaster County, Pennsylvania. The ultramafic rock is faulted, folded, and, at the Wood Mine, contains horizontal magnesite layers. Chromite occurs as disseminated grains, trails of aggregated grains, small veins, and in pockets or "pipes." Early olivine, enstatite, and chromite have been altered during serpentinization. Early-formed chrysotile has been altered contemporaneously with the formation of late chrysotile, kammererite, and late chromite. A preliminary attempt at economic evaluation suggests that the chromite cannot be classed as an ore at present. --Auth.

1-251. Anderson, Alfred L. URANIUM, THORIUM, COLUMBIUM, AND RARE EARTH DEPOSITS IN THE SALMON REGION OF LEMHI COUNTY, IDAHO: Idaho Bur. Mines & Geology, Pamph. 115, 81 p., 5 illus., 5 maps, July 1958.

This report deals with (1) uranium, (2) monazite and columbium-bearing rutile, and (3) thorite-rare earth deposits in the Salmon region of Lemhi County, Idaho. These deposits were unknown prior to 1950 and have not been extensively explored. They appear to possess substantial reserves of thorium and rare earth metals as well as appreciable reserves of columbium and uranium.

The uranium is found in metamorphosed rocks, in volcanic rocks, and in lake beds. Those of greatest promise are in metamorphosed sedimentary rocks and in volcanics. The known ore minerals are autunite, torbernite, and uranophone.

The monazite and columbium-bearing rutile deposits represent a type recently recognized as belonging to the carbonatite group and are characterized by a concentration of rare earth elements. The deposits occur locally as structurally controlled replacements of crystalline limestone and gneissic and schistose rocks in the metamorphic border zone of the Idaho batholith. Most of the known deposits are small and show a sporadic and irregular distribution of minerals.

The thorite-rare earth deposits are contained in veins and lodes largely in quartzitic and phyllitic rocks of the Precambrian Belt series, although some cut the granitic rock of the Idaho batholith. The deposits are thus younger than the batholith and are believed to be associated genetically with late Cretaceous or early Tertiary magmatic activity. --K.M. Hollenbaugh

1-252. Finnell, Tommy L., and William B. Gazdik. STRUCTURAL RELATIONS AT THE HIDEOUT NO. 1 URANIUM MINE, DEER FLAT AREA, SAN JUAN COUNTY, UTAH: Econ. Geology, v. 53, no. 8, p. 949-57, 4 figs. incl. maps, Dec. 1958.

The Hideout No. 1 uranium-copper mine is in sec. 14, T. 36 S., R. 17 E., Salt Lake meridian, about 30 miles N. 86° W. of Blanding, Utah.

Consolidated sedimentary rocks exposed in the vicinity of the mine range in age from Permian to Triassic. The rock units, from oldest to youngest, are: the Cedar Mesa sandstone member, the Organ Rock tongue, and the Hoskinnini tongue of the Cutler formation of Permian age; the Moenkopi formation of Early and Middle (?) Triassic age; and the Shinarump member, the mudstone-sandstone unit, and the Moss Back member of the Chinle formation of Late Triassic age.

The area is on the W. flank of the Monument upwarp, and the beds dip 1° to 3° W.-SW. Local monoclines interrupt the regional dip. The prominent joint sets dip steeply and trend N. 45° to 55° E., N. 35° to 70° W., and N. 10° E. to N. 25° W.

The Hideout No. 1 uranium-copper deposit is in the Shinarump member of the Chinle formation where it fills a stream channel cut in the top of the Moenkopi formation. The apparent relation between the uranium-copper deposit and a low-amplitude monoclinal fold may be explained in the following ways:

1. The beds may have been folded before the Shinarump member was deposited, as suggested by the apparent erosional thinning of the Moenkopi formation along the anticlinal bends; and the flexures may have altered the course and gradient of the Late Triassic streams and perhaps caused thick sediments to accumulate locally.
2. Regardless of whether the beds were folded before or after deposition of the Shinarump member, the local flattening of dip at the Hideout No. 1 channel may have slowed and guided laterally migrating ore solutions into the channel sediments where ore deposits could form.
3. Tension joints associated with the flexure in the Moenkopi formation may have been pathways that allowed ascending ore solutions to reach the channel sediments.

Thus, the intersection of channels and flexures may be guides to favorable ground for uranium deposits in the Shinarump member of the Chinle formation. --Auth.

1-253. Hill, Patrick Arthur. BANDED PYRITE DEPOSITS OF MINAS CARLOTA, CUBA: Econ. Geology, v. 53, no. 8, p. 966-1003, 16 figs., Dec. 1958.

The orebodies of the Minas Carlota are steeply dipping pyrite lenses arranged en echelon in isoclinally folded limestones. The lenses occur at faulted contacts with serpentinite or in tensional fold areas.

Mineralization was in the approximate order: (1) sphene, picotite; (2) actinolite, albite; (3) quartz, calcite, chlorite; (4) anomalous quartz, rutile, sericite; (5) fine-grained pyrite; (6) coarse pyrite; (7) chalcopyrite; (8) sphalerite; (9) galena. (1) represents a magmatic or contact-metamorphic phase, (2) dynamic metamorphism, (3) a phase immediately preceding pyritization, while (4) overlapped with (5) and (6). Early pyrite (5) originated by replacement of limestone along graphitic laminae concurrently with rock folding, at a suggested temperature of 600° C. Later pyrite (6) formed at lower temperatures as a space-filling. (7), (8) and (9) comprise less than 10% of the ore. Post-ore deformation is limited to marginal ore and represents differential adjustment to late faulting.

Chemical studies suggest that low gold, cobalt and nickel values are contained in the fine-grained pyrite.

Of pyrite crystals the cube is the only euhedral form in gangue (?), whereas in the late pyrite (6), cubes modified by an octahedral zone, and possible pyritohedrons are present. A search of the literature suggests that: i) the cube is the commonest form of pyrite, ii) the cube is dominant in veins containing sericite, chlorite and carbonate, iii) the cube where associated with anomalous fringing quartz has grown contemporaneously with rotation and rock movement, iv) the pyritohedron develops at higher temperatures than the cube, v) pyrite octahedrons from mesothermal deposits invariably contain slight manganese values.

The ores are regarded as hydrothermal. Their occurrence adjacent to serpentinite is considered an indication of structural control rather than of contact metamorphism. Crystallization of the upper portion of the magma may have led to sulfide enrichment at depth. Renewed earth movement forced the ore fluids upwards along the flanks of the intrusions.

Serpentinization preceded pyritization. A decrease in volume on serpentinization created tensional areas in the limestone which were infiltrated by the ascending ore fluids. Mineralization and serpentinization are believed closely related in time and may be post-Jurassic, pre-Maestrichtian.

The Carlota orebodies are parallel to regional structure. An investigation into the geotectonic implications of such orebodies is long overdue. --Auth.

1-254. Mertie, John B., Jr. ZIRCONIUM AND HAFNIUM IN THE SOUTHEASTERN ATLANTIC STATES: U. S. Geol. Survey, Bull. 1082-A, p. 1-28, Nov. 1958.

The principal source of Zr and Hf is zircon, though a minor source is baddelyite, mined only in Brazil. Zircon is an accessory mineral in igneous, metamorphic, and sedimentary rocks, but rarely occurs in hard rock in minable quantities. The principal sources of zircon are therefore alluvial deposits, which are mined in many countries of 5 continents. The principal commercial deposits in the United States are in Florida, though others exist elsewhere in the southeastern Coastal Plain.

The evidence indicates that conditions for the accumulation of workable deposits of heavy minerals were more favorable during the interglacial stages of the Pleistocene epoch than during Recent time. Therefore detrital ores of large volume and high tenor are more likely to be found in the terrace deposits than along the present beaches. Other concentrations of heavy minerals, however, are possible at favored sites close to the Fall Line where the Tuscaloosa formation rests upon the crystalline rocks of the Piedmont province.

A score of heavy and semi-heavy minerals occur in the detrital deposits of Florida, but the principal salable minerals are ilmenite, leucoxene, rutile, and zircon, though monazite and staurolite are saved at some mining plants. Commercial deposits of heavy minerals are generally required to have a tenor of 4%, though ores with a lower tenor can be mined at a profit if the content of monazite is notably high. The percentages of zircon in the concentrates range from 10 to 16%, and in eastern Florida from 13 to 15%. Thus the tenor in zircon of the ore-bearing sands ranges from 0.4 to 0.6%.

The content of Hf in zircon is immaterial for many uses, but for some purposes very high or very low tenors in Hf are required. Alluvial zircon cannot be separated into such varieties, which, if needed, must be obtained from sources in bedrock. It thus becomes necessary to determine the Hf:Zr ratios in zircon from many kinds of bedrock.

Granitic rocks are the principal sources of zircon, though not the best sources of zircon with a high tenor in Hf. A general study by the [U.S.] Geological Survey of the granitic rocks of the Southeastern Atlantic States has been in progress for 10 years, and hundreds of samples of granitic accessory minerals have been acquired. Thirty samples of zircon from these collections were selected for spectrographic and X-ray determinations of their tenors in Hf. Nine other samples of alluvial zircon were included, of which 3 are from Florida and 6 from foreign countries. No domestic zircon was discovered with very high or very low tenors in Hf.

The volume of zircon in the southeastern Coastal Plain is enormous, but most of it is not recoverable. The minable reserves of heavy minerals, however, are very large, and from these it is estimated conservatively that 10 million short tons of zircon can be obtained. The corresponding amounts of Zr and Hf, using the mean Hf:Zr ratio of deposits in Florida, are 4,868,000 and 112,000 tons respectively. These reserves could be delivered, if needed, at the rate of 100,000 tons a year. --Auth.

1-255. Brobst, Donald A. BARITE RESOURCES OF THE UNITED STATES: U.S. Geol. Survey, Bull., 1072-B, p. 67-130, figs. 3-4, pl., Dec. 1958.

Barite ($BaSO_4$) is widely distributed in the United States; the greatest production is now obtained from Arkansas, Missouri, Nevada, and Georgia. Nearly half of the States have yielded some barite or have potential resources. Since World War I domestic production has climbed steadily, reaching more than one million tons in 1956. About 90% of the barite consumed annually in the United States is used by the oil industry for drilling mud and the other 10% by the chemical and other industries in many processes and products. Barite is a desirable industrial mineral because it is generally white in powder form, heavy, mainly non-abrasive, and available in large quantities.

Barite occurs in sedimentary, igneous, and metamorphic rocks in many geologic environments. Most deposits can be classified as vein or cavity-filling, bedded, and residual.

Vein or cavity-filling deposits are commercially most important in the West. Barite in veins is commonly associated with fluorite, calcite, dolomite, quartz, and sulfide minerals, including chiefly pyrite, chalcopyrite, galena, and sphalerite, and their oxidation products. Rare-earth, Au, and Ag minerals are associated with some western deposits. Some of the associated minerals may be recovered as by-products or co-products.

Bedded products of commercial importance are found in Arkansas, Nevada, Idaho, and California in sedimentary rocks of late Paleozoic age. The barite is fine-grained and accompanied by chert, pyrite, secondary iron oxides, and various carbonate and clay minerals.

Residual deposits are abundant in Georgia, Tennessee, Virginia, and Missouri, where they generally occur in the residuum derived from the weathering of sedimentary rocks, especially the readily soluble limestones of Cambrian and Ordovician age. Most of the barite is white and forms mammillary, fibrous, or dense, fine-grained masses. Pyrite, galena, and sphalerite occur with barite in some deposits. Chert, rock fragments, and red, yellow, or brown clay make up the rest of the deposits.

An index map and tables illustrate and list the location, summarize the geology, and cite literature pertaining to over 100 prospects, mines, and districts in the United States.

The demonstrated reserves in the United States are estimated to be about 285 million tons containing about 46 million tons of barite. The inferred reserves are large - more than 365 million tons of material containing about 67 million tons of barite. The greatest reserves are in the residual deposits of Missouri, the bedded deposits of Arkansas and Nevada, and the various deposits of California and other western States. --Auth.

1-256. Krasheninnikov, G. F. SOVREMENNAYA GRANATOVAYA ROSSYP' NA BEREGU GALICHSKOVO OZERA [CONTEMPORARY GARNET PLACER ON THE BANKS OF THE GALICHSKOYE LAKE]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 149, 1958.

Resume of lecture given March 14, 1958. In 1954 the author discovered placer deposits of garnet sands, and gives the exact location and the type at the Galichskoye lake (58°24'N. 42°18'E.). --LC

1-257. Govett, G. J. S., and P. J. S. Byrne. INDUSTRIAL MINERALS OF ALBERTA: Research Council Alberta, Geol. Div., Prelim. Rept. 58-2, 112 p., illus., 1958, approx. 100 refs.

The value of industrial minerals produced in Alberta was 5 million dollars in 1946 and increased to 20 million in 1956. All published and unpublished information available upon the industrial minerals resources in Alberta is summarized.

Clays and shales (including bentonite, brick and tile clay, stoneware and refractory clays, and materials suitable for lightweight aggregate), dolomite, gypsum, limestone, phosphate, salt, sodium sulfate, sulfur and helium in natural gas, magnesium, bromine and iodine in oil-field waters receive consideration in individual chapters. Data on such minerals as marl, pumacite and talc are briefly reported.

The known distribution and probable reserves of industrial minerals are given, and in some cases areas where prospecting may reveal other deposits are suggested. Production statistics are listed for most minerals. --Auth.

1-258. Murray, Haydn H. PENNSYLVANIAN UNDERCLAYS - POTENTIAL BONDING CLAYS FOR USE IN FOUNDRIES: Indiana Geol. Survey, Rept. Prog. 11, 27 p., 6 figs., 1957.

Laboratory tests show that 5 underclays from western and southwestern Indiana are potential sources of bonding clay for foundries. Green and dry strength tests were determined for each sample, and the results of these tests were compared with the results of tests obtained from a commercially used bonding clay. The particle-size distribution and the mineral composition of the underclays are most important in interpreting the results of physical tests. The samples which had a high clay content and a rather high percentage of montmorillonite produced the best green and dry strength test results. Five areas in Indiana are most favorable for commercial production of bonding clays: Vigo and Vermillion counties where Coal VII has been and is being mined by stripping methods; parts of Clay, Vigo, and Parke counties where Coal III has been and is being stripped; parts of Vigo, Clay, Greene, and Sullivan counties where Coal V has been and is being stripped; Daviess County, where Coal IV has been stripped extensively; and parts of Pike, Gibson, and Warrick counties where the Lower Millersburg coal has been and is being stripped. --Auth.

1-259. Murray, Haydn H., and John M. Smith. LIGHTWEIGHT AGGREGATE POTENTIALITIES OF SOME INDIANA SHALES: Indiana Geol. Survey, Rept. Prog. 12, 42 p., 7 figs., pl., 1958.

Laboratory tests show that some Indiana shales are potential sources of manufactured lightweight aggregate. Bloating, the process by which lightweight aggregates are manufactured, is caused by various constituents acting singly or in combination. Chemical composition and mineral composition of the shales and particle-size distribution of the mineral constituents are interrelated, and all of these factors contribute to the bloating of shales.

Twenty-nine samples of shales were collected in Indiana and were analyzed in the Clay Laboratory of the Geological Survey. Twenty-one of these tested samples bloated. The New Albany, New Providence, and Bethel shales (Mississippian) and the shales above Coal VII in the Dugger formation (Pennsylvanian) bloated best. --Auth.

1-260. Faick, John N. GEOLOGY OF THE ORD MINE, MAZATZAL MOUNTAINS QUICKSILVER DISTRICT, ARIZONA: U. S. Geol. Survey, Bull. 1042-R, p. 685-98, fig., pls. 58-60, geol. map, scale 1 in. to 250 ft., Dec. 1958.

The Ord mine property comprises 20 patented claims situated on the eastern slope of the Mazatzal Mountains in central Arizona. This is one of several mines and prospects in a quicksilver district that crosses the middle part of the Mazatzal Mountains and occupies part of Gila County on the E. and Maricopa County on the W. The Ord claims were established in 1925, and intermittent production to the end of 1955 is estimated at about 2,100 flasks of quicksilver produced mostly during periods of favorable prices. On the Ord property, ore has been mined from 4 separate localities; these are at hill B, hill C, workings 1, and at the Indian workings.

The rocks in the Ord mine area are metamorphosed formations of the Alder group of the Precambrian Yavapai series. They consist of gray and maroon slates and phyllites, some of which are gradational into or are interbedded with grit, and conglomerate and quartzite beds. The beds strike N. 60°-80°E. and dip steeply N. or are nearly vertical. The slates and phyllites are conspicuously foliated about parallel to the bedding. A few dikes, both felsic and mafic, are exposed in the area.

Quicksilver ore occurs in the phyllites and is closely associated with conspicuous zones of bleaching and alteration in which the phyllite has been converted to sericite schist, seemingly by processes associated with ore deposition. These altered zones, called ore zones if they contain appreciable amounts of quicksilver, are localized along inconspicuous shear zones and bedding-plane faults that are approximately conformable to the foliation of the phyllites. The ore occurs in small, narrow, lenticular bodies most of which strike E.-NE., stand nearly vertical, and rake steeply W. The ore bodies are irregular in shape, and few have definite walls; some have central parts of comparatively high-grade ore which grades outward into submarginal ore or barren wallrock. Most of the ore consists of cinnabar disseminated in altered phyllite; however, cinnabar also is present in narrow quartz veins, some of which contain considerable amounts of siderite. A little native Hg is found in the upper parts of the ore bodies, and mercurian tennantite is abundant in the ore exposed in the lower workings of the Ord mine.

Undiscovered ore bodies might exist in structurally deformed zones in which the slates and phyllites have been bleached and altered, but, if present, the ore bodies are likely to resemble those now known and are apt to be expensive to discover and explore. The deepest ore found at the Ord mine is about 375 ft. below the outcrop, and this relatively shallow depth indicates that considerable caution should be used in future exploration for downward extensions of the ore bodies. --Auth.

1-261. Webster, Russell. **EXPLORATION EXTENDS MAGMA'S FUTURE: Mining Engineering, v. 10, no. 10, p. 1062-65, illus., 3 figs. incl. sec., Oct. 1958.**

Located on the northwestern boundary of a mineral district in Arizona that includes such past and present major copper producers as Inspiration and Miami Copper Co. at Miami, the Old Dominion Mine in Globe, the Ray Mine in Ray, and to the S. the new San Manuel Mine near Tucson, the Magma Mine is unique in that it has maintained production for over 40 years.

The Magma Copper Co. has in its east replacement ore body a potential that as recently as 6 years ago was little known. Located about 2,000 ft. E. of the vein area in the central portion of the mine, the east replacement bed can be considered as a separate mining unit with exploration, development, and mining problems that are peculiar to this area alone. If these problems can be satisfactorily solved and if a favorable national economic situation exists, the east replacement ore body will give additional life to the long productive Magma Mine. --Auth.

1-262. Dort, Wakefield, Jr. **GOLD-BEARING GRAVELS NEAR MURRAY, IDAHO: Idaho Bur. Mines & Geology, Pamph. 116, 21 p., 3 illus., 2 maps, Aug. 1958.**

Gold was first discovered in the Murray area of Idaho in 1883. The strike was made on Prichard Creek, a major tributary of the Coeur d'Alene River in the panhandle of northern Idaho.

Bedrock in the area consists almost entirely of slightly metamorphosed sedimentary strata belonging to the Precambrian Belt series. Monzonite stocks and diabase dikes of limited extent are found in the area.

The rocks of the area have been deformed into a series of irregular N.-S. folds which have in turn been broken by numerous high-angle normal and reverse faults.

Deposits of unconsolidated sediments in the area are broadly divisible into 2 groups: bench or terrace gravels, and valley-floor alluvium. This division is made largely upon the basis of present topographic position of the debris, but 2 distinct episodes of deposition are represented and 2 periods of geomorphic history are indicated.

The bench gravels were derived from the Belt strata in the drainage basins of the streams along which the deposits are located. The gravels display extreme variations in particle size.

Gold was first concentrated in the alluvium which was deposited during a previous cycle of erosion and which now constitutes the bench gravels. Some of this gold was further concentrated when gulches of the present cycle were cut through the former deposits which were then reworked. --K.M. Hollenbaugh

1-263. Folwell, William T. **LUCKY FRIDAY MINE: HISTORY, GEOLOGY, AND DEVELOPMENT: Mining Engineering, v. 10, no. 12, p. 1266-68, fig., Dec. 1958; also pub. in AIME Trans., v. 211, 1958.**

The Lucky Friday mine E. of Mullan, Idaho, is an outstanding example of a property in the Coeur d'Alene district where a small and insignificant-appearing Ag-Pb-Zn vein at the surface has changed at depth into a large vein of great importance. The vein has little surface expression, and above the 1200 level the ore shoots are small and discontinuous. Between the 1200 and 2450 levels the main ore shoot has shown remarkable improvement on each succeeding lower level, and today the mine is one of the major Pb-Ag producers in the district. Ore reserves have been estimated to provide 19.2 years of operation beyond Feb. 1958, based on the average yearly production of 40,000 tons maintained at the present time. --Auth.

1-264. West Virginia Geol. & Econ. Survey and U. S. Bur. of Mines. **THE MINERAL INDUSTRY OF WEST VIRGINIA (1955-1956): 15 p., 1958.**

This paper discusses and tabulates amounts and values of mineral products in West Virginia during the years 1955 and 1956. It also includes brief individual discussions of the mineral production of each county. The important items treated are coal, natural gas, natural gas liquids, stone, sand and gravel, petroleum, and salt. So far as practical, production is tabulated by individual counties. --Auth.

1-265. Wallace, Keith G. **LUCKY Mc EMPLOYS ASSAYS, CAREFUL OPEN PIT SLICES: Mining Engineering, v. 10, no. 10, p. 1070-73, illus., Oct. 1958.**

The Lucky Mc mine is located in the Gas Hills Uranium District of central Wyoming, about 50 mi. E. of the city of Riverton. The Gas Hills District (embracing about 200 sq. mi.) in the 4 1/2 years since the initial uranium discovery was made, has become the hub of one of the most important uranium-producing areas in the country - the central Wyoming uranium region of some 10,000 sq. mi.

It became apparent during 1955 that substantial ore reserves occurred on the Lucky Mc property, and a mill to treat the ores might therefore be justified. At this point Lucky Mc invited Utah Construction Co. to participate in the venture.

So far the following has been accomplished: exploration of the Lucky Mc property and development of a sufficient tonnage of ore to justify a mill proposal; negotiation of a milling contract with the Atomic Energy Commission; securing financing for the mill and accessory facilities; and the design and construction of the mill, camp, and mine plant.

Mine problems encountered and methods of solution and operation are covered in detail.

With the present mine organization and equipment it is planned to strip over 5,000,000 cu. yds. this year and mine sufficient ore to build up sizeable ore stockpiles in addition to supplying the current ore requirements of the mill. --Auth.

1-266. Scott, J. B. STRUCTURE OF THE ORE DEPOSITS AT SANTA BARBARA, CHIHUAHUA, MEXICO: Econ. Geology, v. 53, no. 8, p. 1004-1037, 14 figs. incl. maps, Dec. 1958.

The Santa Barbara mines are grouped in a circle around the village of Santa Barbara in the Parral mining district, southern Chihuahua. The mines are operated by American Smelting and Refining Company and the bulk of the mineral production comes from 11 vein systems.

The pre-mineral rock types consist of a thick calcareous shale formation and andesite flows. The post-mineral rock types consist of dikes and sills of rhyolite and diabase, a thin conglomerate formation, basalt flows, and unconsolidated stream sediments. Pre-mineral faulting took place in 2 stages, forming 4 fault systems. Any fault within one system is similar in both strike and dip to another fault within that system. Movement along these faults, vertical in the first-stage faults and horizontal in the second-stage faults, formed openings, breccia zones, and in places horses and wedges of country rock in the faults. The location and explanation of these openings, breccia zones, horses and wedges are the main topic in this paper.

Hydrothermal solutions, emanating from depth, were introduced into the faults. The walls and breccia fragments within the faults were silicated and silicified, and the high-temperature silicates, garnet, pyroxene, epidote, and idocrase (?) were formed. Accompanying and following the formation of the silicates, the sulfides, sphalerite,galena, chalcopyrite, pyrite, and arsenopyrite, with associated gold and an unknown silver mineral, were introduced with quartz, calcite, and fluorite. Most of these minerals replaced the silicates and altered shale. The parts of the faults where wide pre-mineral openings, horses or wedges were formed, were filled with quartz and a higher ratio of sulfides than the narrow portions of the faults. Quartz, calcite, fluorite, and barite were among the last minerals deposited. The veins are assigned to the hypothermal class of hydrothermal deposits. --Auth.

1-267. Bracewell, Smith. JAMAICAN BAUXITE IN THE WEST INDIES ECONOMY: Mining Engineering, v. 10, no. 10, p. 1079-80, illus., Oct. 1958.

First evidence of bauxite in Jamaica resulted from an analysis of a soil sample collected at Bull Savannah in 1938 during a systematic local investigation of the island's soil types.

Close to large markets and processing some of the world's largest bauxite deposits, Jamaica expects stepped-up mining will bring production of 6 million tons annually by 1959.

The industry is therefore an important asset, not only to Jamaica itself, but to the West Indian Federation as a whole. Like the oil industry of Trinidad, it should serve to strengthen the Federation and to ensure its economic stability and independence. --Auth.

1-268. Bobrov, Ye. T. DREVNYAYA KORA VYVETRIVANIYA V RAYONE VOSTOCHNOY OKRAINY YENISEYSKOGO KRYAZHA [ANCIENT EROSION CRUST OF THE EASTERN BORDERLAND OF THE YENISEY RIDGE]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 150, 1958.

Resume of lecture given March 14, 1958. This region is located at the eastern borderland of the Yeniseyskiy Kryazh (ridge, 59°N. 93°E.) near the watershed of the right tributaries of the Yenda and Tonaul rivers. The ancient erosion crust was discovered by V. V. Petrov and I. K. Kusov. The weathered layer, formed over basalts with the development of bauxites, reaches a thickness of 100 m. The author subdivided the weathered crust into 4 layers, and classified them as belonging to the Upper Cretaceous or Lower Paleogene periods. Apparently, the ancient zone of erosion extends over several hundred kilometers from the area examined. Likewise, the accumulation of bauxite deposits took place over a large area, predominantly in basaltic regions. The author recommends further prospecting for erosion crusts, both on the Siberian plateau and the Yeniseyskiy Kryazh for the purpose of locating primary deposits of bauxite. --LC

1-269. Korzhinskaya, K. N. STRUKTURA RUDNOGO POLYA SLYUDYANSKOGO MESTOROZHDENIYA FLOGOPITA [THE STRUCTURE OF THE SLYUDYANKA PHLOGOPITE DEPOSITS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 69-83, 7 figs., 6 refs.

The Slyudyanka phlogopite deposits, situated in the southern part of the Lake Baikal region (54°N. 109°E.) are divided into 2 formations: 1) the upper, formed of crystallized limestone; 2) the lower, composed mainly of garnet and biotite gneisses. The whole region is of an exceedingly complex isoclinal folding structure. The author describes this structure in detail. She found that the economically-important deposits of phlogopite were in the pyroxene-amphibolic gneisses of the upper formation and in the leucocratic biotite gneisses and diopside rocks of the lower formation. --LC

13. FUELS

See also: Geologic Maps 1-11, 1-12, 1-15, 1-16, 1-50, 1-52; Areal and Regional Geology 1-59, 1-64; Stratigraphy 1-97.

1-270. Khutorov, A. M. O FORMIROVANII VTORICHNYKH ZALEZHEY NEFTI V FERGANSKOY DEPRESSII [ON THE FORMATION OF SECONDARY OIL DEPOSITS IN THE FERGANA DEPRESSION]: Geologiya Nefti, no. 7, p. 34-41, 1958.

About 40 old, inactive boreholes were restored for exploitation during 1957 in the Andizhan group of the Fergana oil deposits, each hole producing 6 to 26 tons of oil per day. It was found that oil had migrated from the lower Paleogene oil deposits through cracks and bed dislocations, and accumulated in the sandstone reservoirs which had been emptied of oil several years ago. The area of secondary oil deposits of the Andizhan group extends from Palvantash to southern Alamyshik, for more than 60 km in an east-west direction. The re-use of formerly exhausted oil wells was found to be economically feasible, and re-exploitation of the oil deposits in Auval', Yarkutan, and Chongara is planned. --A.J. Shneiderov

1-271. Hitchon, Brian. PRELIMINARY REPORT OF A STUDY OF THE REGIONAL VARIATIONS IN COMPOSITION OF CRUDE OILS, NATURAL GASES, AND FORMATION WATERS IN SELECTED ANCIENT BASINS OF WESTERN CANADA: Research Council Alberta, Contr. no. 75; also pub. in: Oil in Canada, v. 10, no. 48, p. 22-28, Sept. 29, 1958.

The regional trends observed from plotting selected components of about 10,000 crude oil, formation water and natural gas analyses from Western Canada are summarized. Such regional trends as exist for one of the fluids can also be demonstrated for the other fluids.

As the A.P.I. gravity of the crude oil increases (7.6 - 59.7° A.P.I.), there is a concomitant decrease in sulfur (10.04 - 0.001 weight %), viscosity (8,660 - 27 S.S.U. at 100°F.) and Conradson carbon residue (12.1 - 0.0 weight %).

Relative to sea water, it was found that as one component of the formation water increased, so did the others (total solids 1/6 - 8, chloride 1/10 - 7, sulfate 1/20 - 2, calcium 1/10 - 70 and magnesium 1/32 - 5).

Increase of any component in the natural gas (e.g. H_2S 0.0 - 43.31%) could not always be correlated with a definite increase or decrease in the other components.

Only sulfur in the crude oil and sulfate in the formation waters showed anomalous patterns.

For all horizons plotted, with the exception of the Basal Quartz (Cretaceous), the lighter oils, sourer gases, and more concentrated formation waters were found associated with the deeper portions of the original basins near the Foothills Belt and the Williston Basin, and the heavier oils, sweeter gases, and more dilute formation waters with the subcrop edges and over the Sweetgrass Arch. The more dilute formation waters and heavier oils were peripheral to the more concentrated formation waters and lighter oils in the Basal Quartz. --Auth.

1-272. Phillips, H. F., and I. A. Breger. ISOLATION AND IDENTIFICATION OF AN ESTER FROM A CRUDE OIL: Geochim. et Cosmochim. Acta, v. 15, no. 1/2, p. 51-56, 2 figs., Nov. 1958.

A dioctylphthalate has been isolated from a crude oil by means of adsorption column chromatography. The ester was identified by means of elemental analysis, refractive index, and its infrared absorption spectrum. Saponification of the isolate and examination of the resultant alcohol by means of infrared absorption spectra led to the conclusion that the ester is a branched chain dioctylphthalate. This is the first reported occurrence of an ester in crude petroleum. --Auth.

1-273. Folsom, Clarence B., Jr., Miller Hansen, and Sidney B. Anderson. PRELIMINARY REPORT ON THE NEWBURG-SPEARFISH CHARLES AND SOUTH WESTHOPE-SPEARFISH CHARLES POOLS: North Dakota Geol. Survey, Rept. Inv. no. 29, 25 p., 11 figs., 1958.

Oil in the Newburg and South Westhope fields is currently produced only from the Mississippian Charles and the Triassic Spearfish formations. Oil is found in stratigraphic traps in the Charles and particularly in the sandy basal Spearfish.

Magnetic mapping shows an anomalous area extending over more than 50 sq. mi. with magnetic closure exceeding 250 gammas. The anomalies are low over the producing areas, ranging from 10 to 50 gammas.

Reservoir studies indicate that both fields are producing by gas expansion. Producible reserves are estimated at 150 barrels per acre foot. --Auth.

1-274. Lytle, William S., John M. Bergsten, Addison S. Cate, and W. R. Wagner. OIL AND GAS DEVELOPMENTS IN PENNSYLVANIA IN 1957: Pennsylvania Geol. Survey, Prog. Rept. 154, 46 p., 4 figs., 5 pls., 1958.

Summarized records of the deep wells (Middle Devonian or older) drilled during the year and a classification of both the deep and shallow wells, exclusive of those drilled for gas storage and secondary-recovery purposes, are given in tables.

Offshore leases in Lake Erie were granted to New York State Natural Gas Corporation in Sept. 1957. The leasing of these 2 blocks gave Pennsylvania the distinction of being the first border state of the Great Lakes to lease offshore acreage. One hundred seventy-three deep wells were completed in Pennsylvania in 1957, with a total footage of 1,202,283 ft. One hundred twenty-one of these were gas wells, 49 were dry holes, and 3 were drilled for gas storage.

The shallow-sand (Upper Devonian or younger) territory of western Pennsylvania had one new field discovery in Elk County and a new pool discovery in Westmoreland County. In all, 955 shallow-sand wells were completed. Of these, 210 were gas wells, 48 were oil wells, 61 were dry holes, and 9 were drilled for gas storage. Six hundred twenty-seven were drilled in connection with secondary-recovery oil operations. --Auth.

1-275. Burke, Ray A. SUMMARY OF OIL OCCURRENCE IN ANAHUAC AND FRIO FORMATIONS OF TEXAS AND LOUISIANA: Am. Assoc. Petroleum Geologists, Bull., v. 42, no. 12, p. 2935-50, 13 figs., Dec. 1958.

More than 5 billion barrels of oil have been produced from the Anahuac and Frio formations in the Texas and Louisiana Gulf Coast. The Frio, with many excellent blanket sands, accounts for practically all of this total; the Anahuac, which is primarily shale, produces only a small percentage from limited sand development. Oil activity on salt-dome structures in the Frio trend dates from the founding of the present oil industry with the discovery of oil at Spindletop and Jennings in 1901. Since that time, the oil industry has discovered approximately 455 fields in Texas, and 160 fields in Louisiana. A great variety of geologic structures together with favorable sedimentation conditions, resulted in forming many traps for oil and gas in the Anahuac and Frio formations. The producing belt for these formations ranges from 40 to 60 mi. wide, and extends approximately 675 mi. from

Mexico to the state of Mississippi. --Auth.

1-276. Ginzburg, A. I. O KLASSIFIKATSIYAKH I NOMENKLATURAKH MIKROKOMPONENTOV UGLEY [ON THE CLASSIFICATION AND NOMENCLATURE OF COAL MICROCOMPONENTS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 88-94, 2 tables, 5 refs.

The author studied various methods of classifying microcomponents of coal. By the old system all microcomponents of humic coals were divided into 4 basic groups, 3 of which represented the products of transformation of vegetable fiber, and the fourth - spores, cuticles and resinous bodies. Another method was presented by I. E. Val'ts. She introduced a series of new denominations. This method is described in detail. The All-Union Petrographic Conference in 1956 established another nomenclature of petrographic coal components, which calls for 5 groups of microcomponents. The author is of the opinion that the old method, with adjustments, is the best method. The Val'ts method could be used for brown coal, and the method accepted in 1956, for coal used for coking purposes. --LC

1-277. Blokh, A. M. VOZRAST I USLOVIYA NAKOPLENIYA UGLENOSNYKH OTLOZHENIY NA YUGO-VOSTOKE PODMOSKOVNOGO BASSEYNA [THE AGE AND CONDITIONS OF ACCUMULATION OF COAL-BEARING DEPOSITS OF THE SOUTHEASTERN SECTION OF THE PODMOSKOVNYY BASIN]: Moskov. Obshch. Ispyt. Prirody, Byull., Otdel Geol., v. 33, no. 3, p. 148-49, 1958.

Resume of lecture given Feb. 28, 1958. The author distinguishes between the Tula and Stalinogorsk coal deposits, the seams of the latter being considerably thicker than those of the Tula district. The extent of the Tula deposits are limited by the width of the inter-river area, while the coal beds of the Tula district are sometimes sapropelic. Sapropelites were not observed within the 5th bed of the Stalinogorsk deposits. The author explains the different thicknesses of coal seams by geologic conditions prevailing at the time of coal formation. --LC

15. MISCELLANEOUS

1-278. Wayne, William J. LET'S LOOK AT SOME ROCKS: Indiana Geol. Survey, Circ. 5, 36 p., illus. (by Robert E. Judah), 1958.

Only in recent years have geologists tried to supply the beginning student of rocks with the type of guides for identification that have long been available for trees, birds, and other aspects of nature study. This brief handbook was prepared to try to help fill the need for such literature. It includes a nontechnical key to most of the common rocks found in Indiana and a discussion of more than 30 kinds of rocks and soil-forming materials. Over 35 sketches and line drawings are scattered through the text to illustrate various technical points and other interesting details. --Auth.

1-279. Anon. LITERATURA PO GEOLOGII I SMEZHNYM DISTSIPLINAM POSTUPIVSHAYA V BIBLIOTEKU OTDELENIYA GEOLOGO-GEOGRAFICHESKIKH NAUK AN SSSR ZA MART 1958 G. [LITERATURE ON GEOLOGY AND ASSOCIATED SUBJECTS RECEIVED BY THE LIBRARY OF THE SECTION OF GEOLOGICAL AND GEOGRAPHICAL SCIENCES OF THE ACADEMY OF SCIENCE OF THE USSR IN MARCH 1958]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, No. 6, p. 110-19.

The list contains references to 164 articles published in Soviet periodicals, 48 Soviet and 32 foreign books, received in March 1958.

A. The articles are categorized as follows: Geology - 58 articles; Paleontology - 12 articles; Petrography, mineralogy, crystallography and geochemistry - 40 articles; Mineral resources, methods of their prospecting and exploration - 34 articles; Hydrogeology and Engineering geology - 9 articles; Miscellaneous - 11 articles.

B. The Books are categorized as follows: Geology - 17 Soviet and 14 foreign; Paleontology - 11 foreign; Petrography, mineralogy, crystallography and geochemistry - 10 Soviet and 2 foreign; Mineral resources, methods of their prospecting and exploration - 17 Soviet and 4 foreign; Hydrogeology, Engineering geology - 4 Soviet and 1 foreign. --LC

1-280. Currier, L. W. ADMINISTRATIVE REPORT ON PROGRESS OF GEOLOGIC MAPPING IN RHODE ISLAND FOR FISCAL YEAR ENDING JUNE 30, 1958, AND STATUS OF THE COOPERATIVE GEOLOGIC PROGRAM: Boston, Mass., Rhode Island Devel. Council & U. S. Geological Survey, 10 p., fold. map, June, 1958.

The Rhode Island geologic program was established in 1944 as a continuing cooperative project between the Rhode Island Industrial Commission (now Development Council) and the U. S. Geological Survey. The project consists of detailed mapping of the State by quadrangles, at first on a scale of 1:31,680, now 1:24,000. Two geologic maps, one showing bedrock geology, the other surficial geology, will be prepared for each quadrangle. Two State geologic maps (proposed scale 1:125,000), also showing bedrock and surficial geology, will be compiled from the quadrangle maps.

In the year ending June 30, 1958, 78 sq. mi. were mapped for bedrock, 46 sq. mi. for surficial deposits. Six quadrangles were involved. To date, 13 quadrangle maps have been published, all by the U. S. Geological Survey under its Geologic Quadrangle Map Series. Twelve quadrangle maps are in preparation and 17 quadrangles remain to be mapped.

Also briefly described are coordination of geologic mapping with ground-water investigations, availability of geophysical services for studies in Rhode Island, equipment and general services, fiscal resources. The cooperative program at present employs 2 full-time geologists, also part-time geologists for additional mapping. --A. C. Sangree

1-281. Price, Paul H. ANNUAL REPORT OF THE DIRECTOR AND STATE GEOLOGIST: West Virginia Geol. & Econ. Survey, Ann. Rept. 1958, 31 p., figs., pls., maps, June 1958.

The report discusses the work and plans of the West Virginia Geological Survey, present mineral production in the State, and prospective future developments. The main mineral products discussed are the fossil fuels, salt, high alumina clay (as a prospective ore of aluminum), silica sand, limestone, building stones, and road materials. Water resources are also discussed, as is the progress of topographic mapping on the new scale of 1/24,000 and the problem of more accurate determination of county boundaries. Educational activity and publicity functions of the Survey are also described. --Auth.

1-282. Helava, U. V. ANALYTICAL PLOTTER IN PHOTOGRAMMETRIC PRODUCTION LINE: Photogrammetric Engineering, v. 24, no. 5, p. 794-97, Dec. 1958.

The analytical plotter is presented in this paper in general terms. Its principles and various advantages are briefly described. Particular attention is paid to the new possibilities offered by the analytical plotter to improve the performance in photogrammetry. It is pointed out that in small-scale mapping an integrated system of analytical methods may lead to a considerable saving of time. The time normally spent for relative and absolute orientations may be almost entirely saved. In large-scale mapping, a total correction for the entire system of photogrammetric mapping may be determined by a calibration over a test area. This is one of the most promising possibilities to increase the accuracy of photogrammetry when the utmost is needed in this respect. For all these improvements the analytical plotter is the key factor necessary for progress. --Auth.

1-283. Hoffman, Pamela R. PHOTOGRAMMETRIC APPLICATIONS OF RADAR-SCOPE PHOTOGRAPHS: Photogrammetric Engineering, v. 24, no. 5, p. 756-64, 10 figs., Dec. 1958.

The utilization of radar-scope photographs as standard photogrammetric source material has been studied for over 10 years. Almost the entire bulk of completed work is experimental in nature but has provided valuable information. It has led to the development of special compilation procedures, and special compilation equipment, as well as the capability of applying these developments in production compilation. Improvement of the basic radar equipment will permit even greater success in this field in the future. This paper describes procedures and techniques for applying a specialized kind of photogrammetric knowledge in extracting topographic information from radar-scope photographs. --Auth.

1-284. Hughes, Thomas A. INSTRUMENTATION FOR STEREOTEMPLETS: Photogrammetric Engineering, v. 24, no. 5, p. 732-36, 3 figs., Dec. 1958.

Supplemental horizontal control has been of continuing interest to photogrammetric research personnel. Stereotemplet triangulation, only a few years old yet a standard mapping tool in the [U. S.] Geological Survey, probably needs a reevaluation from the point-of-view of instrumentation. Research has been initiated to determine the most suitable templet materials and methods of preparing templets. One proposal is for a variable-ratio slot cutter, and this is considered worthy of practical tests. The theory involved in stereotemplets and the requirements for reducing the scale, model-to-publication, seem to be conducive to the development of such an instrument. --Auth.

1-285. Kedar, Yehuda. A GEOGRAPHIC APPROACH TO THE STUDY OF PHOTO INTERPRETATION: Photogrammetric Engineering, v. 24, no. 5, p. 821-24, 2 illus., Dec. 1958.

Since the air photo is a representation of the landscape, no photo can be interpreted without an understanding of what makes up the landscape. A curriculum in photo interpretation should include the following stages: the rudiments of morphology, geology, and other earth sciences; after these have been assimilated, the basic principles of air photography; later, the more advanced principles of physical geography and the study of man-made features in the landscape; and only then photo interpretation. Interpreters trained by this method will be successful both in forestry and civil engineering and will be able to take up independent research in the earth sciences. --Auth.

1-286. Le Resche, John. ANALYSIS OF THE PANORAMIC AERIAL PHOTOGRAPH: Photogrammetric Engineering, v. 24, no. 5, p. 772-75, 3 figs., Dec. 1958.

An examination of the panoramic aerial photograph reveals certain points of interest to the photo interpreter. Each photograph covers a narrow, horizon-to-horizon strip transverse to the flight line. The photo is vertical along its principal x-axis and oblique elsewhere, with the tilt angle increasing along the principal y-axis. The horizon-to-horizon view has advantages to the photo interpreter where a broad expanse of terrain is desired, such as in charting or reconnaissance. However, the panoramic photograph must be rectified to recover essential elements of the photo image, namely, the position, alignment and dimensions. At first glance, the photo interpreter may feel that the problems involved in rectifying a photograph with a constantly increasing tilt-angle makes its use impractical.

The problems of rectification may be simplified, however, by utilizing certain advantages inherent in the geometry of the panoramic photograph. Each photograph can be considered a segment of a cylinder which has been projected onto a plane. Consequently, the principal y-axis (or principal line) of the photograph is a segment of a circle rather than a straight line. Therefore, each light ray intersects each point along the principal line at right angles. It is suggested that this property of the panoramic photograph may lead to the use of radian measurements rather than linear measurements in its rectification, thereby achieving the simplification desired. --Auth.

1-287. Miller, Charles I. THE STEREOSCOPIC SPACE-IMAGE: Photogrammetric Engineering, v. 24, no. 5, p. 810-15, 4 figs., Dec. 1958.

In this paper is developed a new method of evaluating the amount of distortion an interpreter obtains in the space-image observed when he views aerial photographs stereoscopically. The method is based on the hypothesis that to produce a "scale model" space image, the apparent distance of a given frontal plane and the interpupillary distance must be in the same ratio as the actual distance of the given frontal plane from the camera base-line and the length of the base-line. --Auth.

1-288. Strees, Leo V. STEREOSCOPIC PROFILE-SCANNING FOR CONTOUR LINE INFORMATION: Photogrammetric Engineering, v. 24, no. 5, p. 775-79, 8 figs., Dec. 1958.

Contours are used to express both the physiographic character of the terrain and to accurately locate the continuum of points of equal elevation. The use of profile-scan technique to obtain contours in the latter sense is discussed. A method of converting the Stereoplanigraph into an interim scanning instrument for determining contour information is described. Applications of profile-scanning to mapping systems are briefly discussed. --Auth.

1-289. Tewinkel, G. C. AEROTRIANGULATION TESTS: Photogrammetric Engineering, v. 24, no. 5, p. 709-13, 4 figs., Dec. 1958.

A test of accuracy of horizontal aerotriangulation was recently conducted by the Coast and Geodetic Survey. The purpose was to derive a basis for predicting the nature of errors to be expected from a flight strip of a given number of models, control points, etc. The results are expressed in the form of an equation for use in project planning. --Auth.

1-290. Case, James B. MAPPING OF GLACIERS IN ALASKA: Photogrammetric Engineering, v. 24, no. 5, p. 815-21, 4 figs., map, Dec. 1958.

As a part of its contribution to the International Geophysical Year program, the American Geographical Society is mapping a number of glaciers in Alaska. The author is the photogrammetrist for this project. A pilot project was first undertaken using available ground-control and photography of the Lemon Creek Glacier in Alaska. In preparing the map of that glacier, the author was able to develop the procedures used in mapping several more glaciers during the summer of 1957. These procedures included both terrestrial and aerial photogrammetric methods. A triangulation network of high accuracy was put in on each glacier, and a sufficient number of points was determined so as to insure a check on the accuracy of the mapping procedures used. A comparison of these mapping methods is now being made. --Auth.

1-291. Mellor, Malcolm. PHOTOGRAMMETRIC FLOW MEASUREMENTS ON ANTARCTIC GLACIERS: Am. Geophys. Union, Trans., v. 39, no. 6, p. 1158, Dec. 1958.

In 1957, velocity measurements of Jelbart Glacier (MacRobertson Land) and the Dovers and Hoseason Glaciers (Kemp Land) were made by aerial photogrammetry by the Australian National Antarctic Research Expeditions. Rock islands and outcrops were used as fixed rock control points, and crevasses or melt chambers at the seaward end of the glaciers were utilized as ground marks on the ice.

The first photographic runs were made in Aug. 1957 at a true altitude of 10,000 ft., giving a scale of 1:20,000 on photographs taken with a 6-in. focal length camera. Only the vertical camera of a trimetrogon installation was used. Runs were repeated in Dec. 1957, and photographs were examined in Australia.

The radial-line method was used to plot fixed control points on rock. Selected common points on the glacier surface were then mapped to the same scale. Comparison of the Aug. and Dec. positions of corresponding points gave a direct measurement of displacement occurring in the 120-day interval. Displacement on the prints ranged from 0.05 to 0.68 in., corresponding to 8.3 to 113 in. per day.

The method could be easily adapted to measure movement of big inland ice-streams if rock control points and reasonably snow-free ice surfaces are present. Use of radar altimeter would be essential. --A.C.Sangree

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